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DISCUSSION PAPER NO. 231

Labour Quality Change in Canada

by Peter Chinloy

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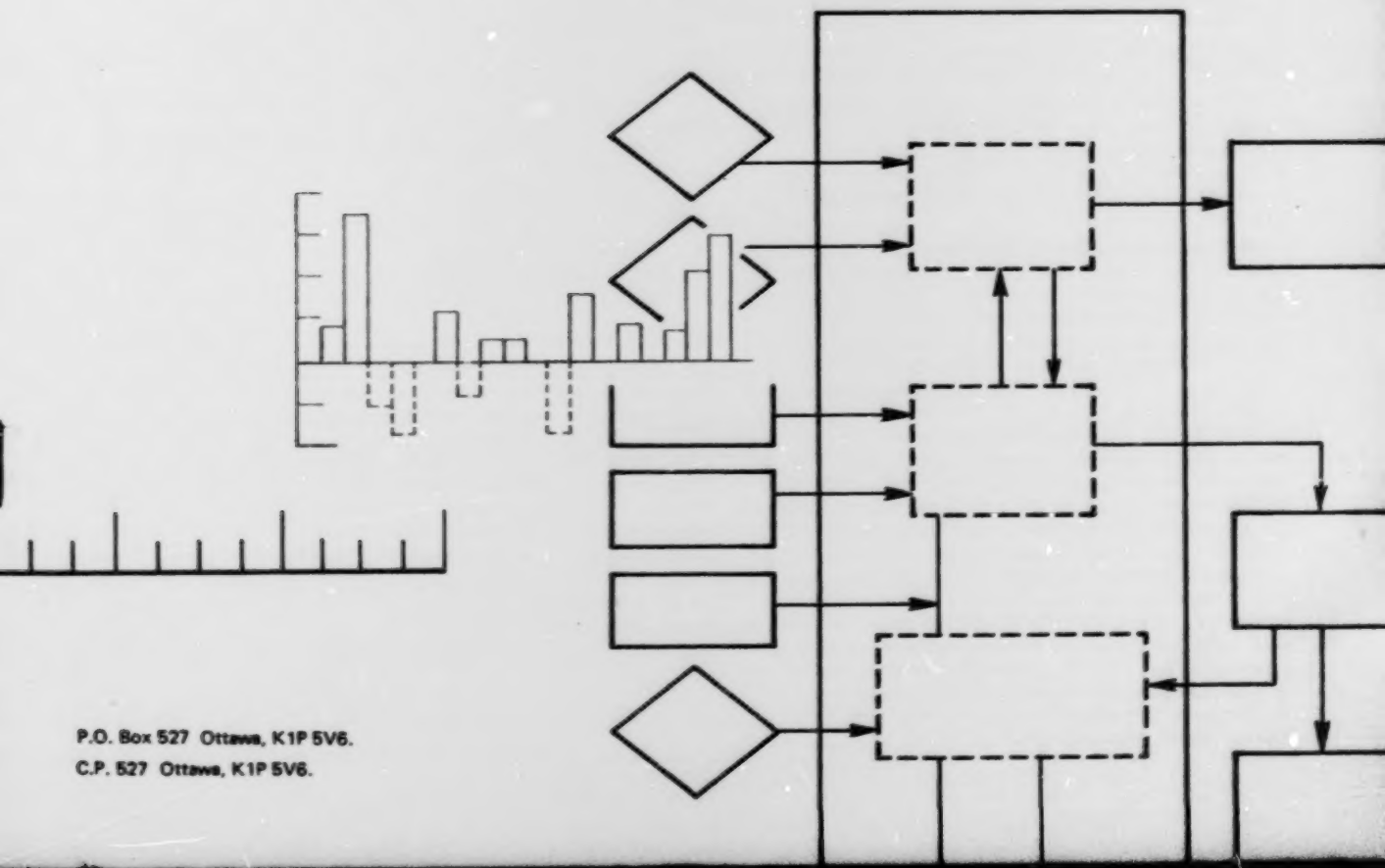

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Résumé

La présente étude tente de déterminer la mesure dans laquelle certains facteurs contribuent à relever la qualité de la main-d'oeuvre au Canada. Elle utilise à cette fin deux séries de données. D'abord, elle tire des listes de paye des renseignements sur les déplacements interindustriels et interrégionaux des travailleurs. Elle effectue ensuite des calculs sur la qualité de la main-d'oeuvre au moyen de correctifs quant au sexe, à l'âge, au degré d'instruction, à la région et à la profession. Elle constate que les déplacements des travailleurs d'une région à l'autre ont eu pour effet d'accroître de plus de 1 % par année la quantité de travail durant les années 70. Par contre, les déplacements inter-industriels des travailleurs contribuent à réduire la quantité de travail et, par conséquent, la productivité. L'effet conjugué des déplacements interrégionaux et interindustriels est moins important durant les années 70 que durant la décennie précédente.

Depuis 1973, ces effets conjugués interviennent pour 0,6 % par année dans la quantité de travail, comparativement à 1 % durant les années 60. Une réduction de la croissance de la quantité du travail a pour effet de réduire le taux de croissance de la productivité de la main-d'oeuvre. Si la productivité de l'ensemble des facteurs est définie comme un résidu, sa grandeur en est également atteinte. Une réduction de la croissance de la

quantité du travail se traduit par une croissance de la productivité de l'ensemble des facteurs.

Le deuxième ensemble de données est tiré des recensements du Canada de 1971 et de 1976. Des renseignements sont compilés sur le sexe, l'âge, le degré d'instruction, la profession et la région. En ce qui concerne la profession, les données ne sont disponibles que pour 1971, étant donné qu'aucune question n'a été posée à ce sujet lors du recensement de 1976. Les particularités concernant le sexe, l'âge, le degré d'instruction et la région contribuent à réduire de 0,24 % par année la qualité de la main-d'oeuvre au cours de cette période. Le degré d'intruction apporte une contribution positive, tandis que celle des autres facteurs est négative.

Enfin, les résultats combinés se caractérisent par un ralentissement de la croissance de la qualité de la main-d'oeuvre. Ces implications sont dérivées des diverses composantes de la qualité de la main-d'oeuvre. La structure sert à préciser la contribution de chaque niveau d'un facteur, tel que les jeunes travailleurs, ou ceux qui ont atteint le niveau d'instruction post-secondaire, et ultimement la quantité de travail et la productivité. Pour ce qui concerne le degré d'instruction, sa contribution totale à la qualité de la main-d'oeuvre intervient pour 0,24 % par année en moyenne, l'éducation post-secondaire représentant à elle seule cinq sixième de cette augmentation. Parmi les groupes d'âge, une augmentation de l'emploi de

travailleurs de moins de trente ans réduit de 0,77 % annuellement en moyenne la croissance de la qualité de la main-d'oeuvre. Le fait s'est vérifié lors d'une forte augmentation de l'emploi de jeunes travailleurs durant les années 70. Les résultats indiquent par ailleurs que l'éducation supérieure a apporté à la croissance une plus grande contribution que tout autre niveau d'instruction.

Enfin, l'étude se trouve à créer, sur le plan théorique, une méthode permettant de combiner les calculs relatifs à la qualité de la main-d'oeuvre et ceux de la productivité, et d'intégrer la qualité de la main-d'oeuvre dans la théorie de la production. La qualité de la main-d'oeuvre peut alors faire l'objet d'un examen plus poussé en fonction de l'évolution de la productivité.

Abstract

This study constructs estimates of contributions to growth in labour quality for Canada. Two alternative data sets are used. Industrial and regional shifts in employment are obtained from payroll sources. Labour quality estimates, adjusting for sex, age, education, region and occupation, are constructed. It is found that regional shifts in employment increase labour input by over one per cent annually during the 1970's. Inter-industry shifts in employment reduce labour input, and thus productivity. The joint effect of regional and industrial shifts is smaller during the 1970's than in the 1960's. Since 1973, these joint effects contribute 0.6 per cent annually to labour input, versus over one per cent during the 1960's. Diminished labour input growth reduces the growth rate of labour productivity. If total factor productivity is defined as a residual, its magnitude is also affected. Reduced labour input growth increases growth of total factor productivity.

The second data set is the Census of Canada for 1971 and 1976. Information on sex, age, education, occupation and region is compiled. For occupation, data are available only in 1971, for no question on this was asked in the 1976 Census. The characteristics of sex, age, education and region act to reduce labour quality by 0.24 per cent annually over this period. Education contributes positively, while the remaining factors contribute negatively.

The combined results point to a slowdown in the growth of labour quality. Implications are derived for the various components of labour quality. The structure develops the contribution of each level of a factor, such as young workers or those with post-secondary education, and ultimately labour input and productivity. Regarding education, the total contribution to labour quality averages 0.24 per cent annually and post-secondary education alone accounts for five-sixth of this. Among age groups, the increase in employment of workers aged less than 30 years reduces labour quality growth by an average of 0.77 per cent annually. This accompanies the large increase in employment of young workers during the 1970's. The results indicate that higher education has made the largest contribution to growth of any schooling category.

Finally, the study also derives theoretically a method for combining labour quality and productivity estimates, and integrates labour quality with a theory of production. This permits labour quality to be integrated with a larger examination of productivity change.

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Chapter 1. Introduction: Labour Quality and Policy Implications

This research reports on the measurement of the contribution to growth of labour input in Canada of employment shifts in the private non-farm sector. Employment shifts include both movements in industrial allocation and labour quality. Labour quality is labour input divided by total hours worked. The index of labour input accounts for skill characteristics in the composition of total hours worked.

The motivation of the study is to examine the contributions of specific employment characteristics such as sex, age and education to the growth of labour quality. Since growth in labour quality is subsequently shown to contribute positively to productivity growth, explanation of the former provides information on the latter. During the 1970's there is evidence that there are increases in the relative employment of younger workers and women generally. The objective is to measure the effect on productivity of this relative movement.

The estimates of employment shifts are constructed first on an industrial and regional basis, from establishment payroll data. These are available on a monthly basis in Canada, using the Employment, Earnings and Hours series of Statistics Canada. Labour quality estimates are constructed based on household characteristics. Those included are sex, age, education, region and

occupation based on individual microdata in the 1971 and 1976 Census of Canada. Data on the first four characteristics are available for both 1971 and 1976, enabling a comparison of labour quality change between the two periods. Data on occupational structure are available only in the 1971 Census. While labour quality cannot therefore be constructed with an occupatinal dimension, it is possible to make projections on skill shifts in the Canadian economy. The four way classification involving the first four factors of sex, age, education and region permits the complete interaction of effects, and is more accurate than procedures where partial indices, for example of sex-age and education, are multiplied together.

The industry classification obtains for a modified two digit grouping, for five regions of Canada. These are the Atlantic provinces (Newfoundland, New Brunswick, Nova Scotia and Prince Edward Island), Quebec, Ontario, the Prairies (Manitoba, Saskatchewan and Alberta) and British Columbia. The data have been selected to yield an uninterrupted monthly time series for an industry and region classification over the sample period. This represents a substantial improvement on previous estimates of labour quality for Canada, usually either interpolated data or leaving gaps between observations.

There is a twofold purpose to this examination. Although data on employment and earnings are insufficient to permit construction of a

long time series, a wide cross section is used, containing 360 categories of labour. For the five regions and the two sexes, there are six age and six education categories. The first objective is to measure labour quality directly, and to assess its importance in contributing to the slowdown in productivity growth in Canada after 1973. Aggregate labour productivity, or output divided by total hours worked, exhibited little growth over 1973-1980, declining in many of these years, in contrast with an average growth rate of 2.59 per cent in Canada for 1962-1972. Since labour productivity can be shown to relate directly to labour quality, the contribution of skill composition to the productivity slowdown can be examined. A similar analysis holds for total factor productivity, or output per unit of an index of inputs.

The question addressed is that of the effects of shifts in age, sex and education on growth in labour quality, and shifts in industrial composition.

The contribution of education is usually measured in studies of labour input and productivity change, but this has no direct policy implication. It is unclear as to what level of education contributes to labour input, whether elementary, secondary or post-secondary. If education contributes 0.6 per cent annually to labour input growth, there is no prescription for investing in one category of education or in all.

The structure estimates the labour quality contribution of each level of education. It is possible to use the results as a guide for the allocation of resources in schooling. It has been argued that the relative wage of the educated declined during the 1970's. From an individual private view, this may make education less attractive as an investment. This does not necessarily reduce the contribution of education to labour quality and ultimately quality growth, for this depends both on relative wages and employment growth of the educated.

Governments contribute extensively towards costs of education. At the post-secondary level, the federal government, as part of the Established Programs Financing (EPF), provides a large part of total expenditure. The cost of these programs is relatively straightforward to measure. The benefit side is less tangible. By measuring the contribution of education to productivity, the benefit of this expenditure, and its efficient allocation between elementary, secondary and post-secondary education can be estimated.

Regarding age, there is evidence of an increase in the relative employment of youth during the 1970's. Since young people receive wages on average below those of older workers, all else equal, this contributes to a reduction in labour quality. For policy purposes, there are two relevant issues. If wages of younger people are in excess of those that would otherwise have prevailed in an unrestricted market, employment may be reduced. The higher relative

wage accompanied by the smaller employment level may affect labour quality, since this depends on growth in employment weighted by the compensation share.

At the other end of the age spectrum are people aged 65 and above. Employment of such workers may be depressed by restrictions such as mandatory retirement. Also, up to 1975 Canada Pension Plan benefits were earnings tested, making it more expensive to hire such labour. If this group has a positive contribution to labour quality, removal of restrictions increases labour quality. If the contribution is negative, this is part of the cost of policies such as the removal of mandatory retirement.

Policy prescriptions on employment by sex are more difficult to determine. It is assumed that existing wage differentials reflect differences in marginal products. This may not be the case, and further, employers may practice statistical discrimination, where the observed wage differences are incorrectly assumed to indicate marginal products. However, the procedure used provides an upper bound for an alleged difference in labour quality contribution by men and women.

There is concern over occupational and skill shortages, and proposals for redirecting general educational funds for job taining. A labour quality effect is computed for each occupation.

This labour quality weight is the difference between shares in compensation and employment. The labour quality effect is the product of the quality weight and employment growth. If skill shortages arise in each occupation, employment growth to ease these shortages can be measured as to contribution to labour quality growth.

By region, there is evidence of movement of employment westward. It is possible to measure the contribution to labour input of such activity. Given that mobility grants are paid to induce workers to relocate, this indicates the benefits. Also, there are costs in lost output from policies encouraging workers to remain in low wage regions.

Extensive research has been undertaken on interprovincial migration in Canada, with the focus on the returns to the individual migrant, or on the supply side. If movement from one region to another increases the lifetime net earnings of a migrant, this is another form of human capital investment. The objective is to measure the contribution of this migratory investment and human capital formation to labour input growth. The explicit assumption is that a migrant from a low wage region faces an unlimited demand for his or her labour services at the prevailing wage in the high wage region. While this may be a plausible assumption at the individual level, it becomes less tenable when applied to the large

scale internal migration occurring in Canada during the period 1961-1979.

The regional analysis of labour quality permits wage adjustments to occur in response to migration, providing more accurate estimates of the contribution of such movements to labour input growth.Further, the demand for labour and its effects in inducing migration are also derived. The purpose of this analysis is to indicate that effectiveness of the programs requires estimates of labour quality, with no examination of the merits or demerits of public intervention.

Some specific programs affected are:

i. Employment training. There has been extensive discussion of the need to increase training for specific employment. A notable case is negotiations surrounding the Fiscal Arrangements Act. The federal government has proposed that funds be redirected from post-secondary institutions to training. The benefits of this policy are greater if the contribution of formal schooling to labour quality growth is declining. Isolating the training requirements involves research into labour quality.

ii. Mobility grants. At present, mobility grants are payable to those willing to relocate to high wage regions. The effect of such grants has tended to be analyzed from the supply or human capital approach, where returns to the migrant are calculated. However, if

mass migration reduces the average wage in the receiving region and increases that in the sending region, the supply approach tends to overstate the benefits of mobility and grants to achieve it.

iii. Identifying high technology sectors. At present, growth in output appears to be a criterion for identifying high technology sectors. However, if labour is subsidized in these sectors, the benefits may accrue only to relatively unskilled workers.

Chapter 2 of this study details the productivity slowdown from the perspective of the labour market. The subsections deal with the effects of labour quality on productivity obtained in other research, and the sources of quality change. The limitations of this research are also discussed. Chapter 3 develops a model of quality change in labour input for Canada. In this chapter, labour quality estimates are constructed directly from a production function. Subsequently, these estimates are shown to be connectedto estimates both of labour and total factor productivity. The data used are described in Chapter 4, from the Employment, Earnings and Hours survey of establishments and the Census data of 1971 and 1976. The empirical results are then reported on and discussed in Chapter 5, first for the industry and region classification. Subsequently, the labour quality index is analyzed for the separate contribution of sex, age, education and region. The primary data source here is the household survey from the one in one numbered samples in the 1971 and 1976 Census. The effect of shifts in skill composition is

examined from occupational projections on employment. Some remarks on policy implications are contained in Chapter 6.

The study extends the analysis of labour quality by permitting the calculation of the effect of each level of factor. The theoretical structure develops the effect of labour quality both on labour and total factor productivity. In the empirical examination, no interpolations are performed, and the data are based on individual observations, not subject to the aggregation bias of sample means. These are the areas in which the study of labour quality and productivity are extended.

Chapter 2. Labour Quality and Productivity: Survey

2.1 The Productivity Slowdown in Canada and the United States and Labour Quality

It has been demonstrated that productivity, either of the labour or total factor forms, has exhibited slower growth during the 1970's in comparison with the 1960's. Documentation of the slowdown is exemplified in Table 2.1 for Canada, from Freedman (1977). Estimates of labour productivity growth of 0.81 per cent annually are obtained, in comparison with 2.59 per cent for 1962-1972.

The decline in productivity growth itself is not directly accounted for by the Freedman (1977) study, but some labour market factors are isolated as components of the change in employment as a proportion of population. The 1.23 per cent growth rate of this ratio for 1962-1972 is the sum of growth rates for civilian non-institutional population aged over 15 to total population, the labour force participation rate and the ratio of employment to labour force. Respectively these growth rates are 0.81, 0.52 and -0.10 per cent for this period. For 1972-1976 employment as a proportion of population increases by 1.96 per cent. The three components grow respectively at 1.14, 1.06 and -0.24 per cent. There is no theory as to how the growth rates of the components contribute to growth in the employment to population ratio. The components may be endogenous or exogenous variables.

Table 2.1 Estimates of labour productivity growth for Canada 1962-1976 (annual average per cent changes)/

		1962-1972	1972-1976
1.	Real gross national product (GNP) per employee (labour productivity)	2.59	0.81
+	Employment as proportion of population	1.23	1.96
=	Real gross national per capita	3.86	2.78
+	International factors	- 0.09	1.05
=	Real domestic expenditure per capita	3.76	3.86

Source: Freedman (1977, Table 1). International factors include changes in the terms of trade and increases in the current account deficit.

Blain (1977) compares labour productivity on a cyclical basis for five postwar cycles,having respective peaks in 1953:2, 1957:1, 1960:1, 1966:2 and 1969:4 where the colon precedes the quarter, with the 1974:1 peak. Labour productivity or total non-farm output per person employed exhibits a more sluggish recovery from recession in the most recent case. Ten quarters after the peak for the five previous postwar business cycles, productivity averages 12 per cent greater than the previous peak. The corresponding increase for the 1974 cycle is only 4 per cent after ten quarters. Various factors are posited for the decline in relative productivity performance, notably changing age and sex composition of the work force, structural shifts among industries, economies of scale and capital intensity.[2] The factors considered appear to explain little of the productivity slowdown for the aggregate Canadian economy, although a greater proportion of the decline in manufacturing productivity is explained.

Direct estimates of labour quality measures for Canadian manufacturing 1949-1969 have been presented by May and Denny (1978) disaggregated by occupation and sex. As for the results reported by Blain, wages of men and women are taken to reflect actual productivity at the margin. If discrimination or other factors independent of productivity conditions lead to wage differentials by sex, the results on labour quality are biased. Since on average women are paid less than men, if female employment is increasing

more rapidly than male employment more weight is placed on lower "quality" workers. If wages contain discriminatory differentials, the resulting labour quality index is biased downwards. This problem arises in all studies of sex effects in labour quality.

The results obtained by May and Denny for labour quality nevertheless indicate that total factor productivity is relatively unaffected by disaggregating labour into occupation and sex categories. This measure of output per unit of aggregate inputs, with 1961 being normalized at unity, is 0.893 in 1949 and 1.098 in 1969, for a 1.03 per cent average annual increase over the period. This is for the case where labour is defined as total hours worked. When labour is defined as total hours worked multiplied by a labour quality index reflecting the services of occupation and sex, the results are similar.

Rao (1979) constructs estimates of total factor productivity for Canadian manufacturing, involving labour, capital and raw materials and energy. The measures are on a two-digit Standard Industrial Classification (SIC) basis. The results confirm that the productivity slowdown is not confined to the aggregate economy, though labour quality is argued not to have been a causal factor. For 1974-1976, total factor productivity in Canadian manufacturing increases by 0.14 per cent annually in comparison with 0.93 per cent for the whole of 1957-1976.

The decline in productivity in the United States has exhibited similar facets to that occurring in Canada. First, measureable factors appear to account for a relatively small proportion of the decline. Norsworthy, Harper and Kunze (1979) argue that 52 per cent of the slowdown in private business labour productivity is attributable to largely unexplainable or unmeasureable factors. An analysis of seventeen causal sources of productivity change by Denison (1979) concludes that these factors have little effect on the slowdown. These studies suggest that labour quality change has had little measureable impact on the productivity slowdown. Baily (1981) in an examination of labour productivity for the United States, claims that a large part of the slowdown is attributable to a failure to modernize capital. One-seventh of the percentage decline in productivity also arises from deteriorating labour quality. This suggests that part of the slowdown may be caused by labour quality, in contrast to other estimates.

A second similarity between the productivity performance of the United States and Canada is that of sluggish recovery in productivity cycles in the 1970's. Gordon (1979) is unable to explain the sudden decline in labour productivity in 1979 for the United States.

To evaluate these obtained results, it is necessary to determine the direction in which labour quality affects labour productivity.[3]

Labour input, or actual services delivered in production, is the product of total hours worked and an index of labour quality, the latter reflecting the average age, education and industrial composition, for example. Growth in labour input is then the sum of the growth rate of total hours worked and of labour quality.

Suppose output is produced by labour, capital, and raw materials, where the last two are already adjusted for quality change. Under certain technical conditions, a sources of growth relation to explain output growth may be derived.[4] Growth in gross output is the sum of four components. Three of these are the growth rates of capital, labour and raw materials multiplied by their share in the value of gross output, the shares summing to unity. The fourth is the estimate of total factor productivity growth, being the difference between the growth of gross output and the sum of the other three components.

Growth of gross output may be decomposed:

	Output Growth	
=	Capital effect	(capital share multiplied by growth in capital services)
+	Labour effect	(labour share multiplied by the sum of total hours and labour quality growth rates)
+	Raw materials effect	(raw materials share multiplied by growth in raw materials used)
+	Total factor productivity growth (residual term)	

which is an accounting identity. Subtracting the growth of total hours from both sides, the left expression becomes the growth of labour productivity. On the right expression, the contribution of labour quality remains multiplied by the share of labour in gross output.

The effect of labour quality on productivity occurs in a form multiplied by its share. If labour quality growth is deteriorating, the effect may be tempered by a decline in labour share. This indicates the context in which the analysis of changes in labour quality may help to explain productivity performance.

2.2 Empirical Estimates of Labour Quality and its Contribution to Productivity Growth

The pioneering estimates for labour quality change in Canada are performed by Walters (1968) at the Economic Council of Canada. Using data from the Census of Canada, adjustments for changes in the composition of employment by age and sex are carried out. The quantities of labour are based on participation rather than employment, and paucity of relative earnings data for Canada requires the use of comparative information for the United States. Nevertheless, Walters is able to produce a quality index for age and sex with the following values, normalizing on 1950=100:

1950	100.0	1955	99.9
1960	98.7	1962	98.3

indicating that the combined influences of age and sex contribute negatively to labour quality.[5]

The quality analysis is extended to education. For education only, again normalized in 1950, the values are:

1950	100.0	1955	102.0
1960	103.8	1962	104.3

for an average contribution to labour input of 0.35 of one per cent per year.[6] As in Denison (1974, 1979) the respective indices for age - sex composition and education are multiplied together, and yield a negative overall growth rate for labour quality. The education growth is less than half that for the United States.

Education is the only productivity characteristic used by Christensen, Cummings and Jorgenson (1980) in their analysis of labour quality change in Canada. The index of educational attainment reads 0.923 in 1947, 1.000 in 1961, the base year, and 1.059 in 1973. For 1950-1962 they obtain an annual growth rate of 0.47 of one per cent, higher than Walters, and 0.52 of one per cent for the whole period.[7]

Occupation and sex estimates of labour quality change are constructed by May and Denny (1978), and reported in Table 2.2. In columns (4) and (5) are indicated labour quality effects, or the share of labour times the growth of labour quality. For the occupation-sex configuration, it is shown that labour quality in

Table 2.2 Labour quality and total factor productivity in Canadian manufacturing 1949-1969 (annual average per cent growth rates)/

	Total factor productivity (Alternative labour input definitions)			Labour quality effect	
	(1)	(2)	(3)	(4)	(5)
	Total hours	Occupation	Occupation-Sex	Occupation	Occupation-Sex
1949-53	1.04	1.05	0.98	0.01	-0.06
1953-58	0.73	0.76	0.65	0.03	-0.08
1958-64	1.25	1.33	1.24	0.08	-0.01
1964-69	1.07	1.01	1.10	-0.06	0.03

Notes:

1. Columns (1) - (3) are derived directly from May and Denny (1978, Table 4).

2. Columns (4) and (5) are derived in the following manner. Total factor productivity growth is $a = y - s_k k - s_L L - s_m m$ where y, k, L and m are growth rates of output, capital, labour and raw materials, and the respective shares of inputs in the value of total output are s_k, s_L and s_m. In column (1) is the measure of total factor productivity where L = h, the growth of total hours. Also $a' = y - s_k k - s_L(h+q) - s_m m$ where q is a labour quality index, and $a' - a = - s_L q$ the labour quality effect. The values of $s_L q$ are reported in columns (4) and (5), where columns (1) and (2) are used to derive the former, and columns (1) and (3) to derive the latter.

3. Data past 1969 were not available on labour inputs, although the study uses other data up to 1974.

Canada declines throughout 1949-1964, because of the increasing relative share of total hours worked by women.

Ostry and Rao (1980) construct estimates of labour quality for Canada as part of their extensive analysis of Canadian productivity performance 1957-1974. They point out that complete quality information, requiring earnings and employment data on an industry specific basis, is typically not available annually for such characteristics as education, age and sex.[8] The procedure for a proxy measure for labour quality is to use the ratio of females and teenaged males in the labour force to the total labour force as an explanatory variable of industry-specific labour productivity. The industry grouping is at the two digit SIC level, mainly including manufacturing.

Labour quality change is insignificant in explaining productivity growth. Only in one of seven durable and three of ten nondurable sectors is the measure significant at the 5 per cent level. For electrical products, a one per cent rise in the labour force share of teenaged males and females reduces gross output per hour by 0.02 per cent. The analogous estimates are reductions of 0.007 in food and beverages and 0.0174 in knitting and clothing.

The results suggest that labour quality changes has a negligible effect on productivity growth, but some caveats apply. First, "low quality" labour is defined to include teenaged males and females only. The cutoff at teenagers for males may be arbitrary. Second, there is no use of wage information to assist in the determination of the degree of quality reduction. Third, all industries are assumed to face the same quality mix of workers. Nevertheless, the estimates indicate that labour quality is a contributing but not a dominant factor in the productivity slowdown.

Hulten and Nishimizu (1980) rely on data constructed by Christensen, Cummings and Jorgenson (1980) on the aggregate Canadian economy to measure the contribution of labour quality to total factor productivity growth for 1947-1973. An education index is used as a measure of labour quality. Labour input growth, the product of indices of total hours and labour quality, accounts for less than one quarter of total factor productivity growth. Labour input increases by 1.1 per cent annually for 1947-1960, and by 2 per cent for 1960-1973, although estimates such as these are sensitive to the specification used.

In the United States, Chinloy (1980) constructs an aggregate labour quality index using the factors of sex, age, education, occupation, and class of worker (employee or self-employed). The resulting indices of labour quality, total hours worked and

labour input for 1947-1974 are indicated in Table 2.3. The results indicate a reversal in the roles of labour quality and total hours in explaining the growth of labour input. For the whole period, labour quality grows at 0.6 per cent annually and total hours by 0.86 per cent, with the former thus accounting for 41 per cent of the total. However, since the early 1960's there has been negligible labour quality change. It remains to determine whether a similar decline in the growth of labour quality has occurred in Canada.

A variety of estimates has been constructed using other characteristics of employment. Christensen and Jorgenson (1973), for an education only index, obtain a growth rate for labour quality of 0.71 per cent annually in the postwar U.S. This estimate may not obtain for the 1970's, where declines in the relative wages of the educated occurred. Star (1974) uses a classification, based on 1950 and 1960 U.S. Census data, for sex, occupation, age, education and race. When total hours are used with no adjustment for labour quality, and value added is the measure of output, total factor productivity increases by 1.41 per cent annually. The inclusion of a labour quality index with the above factors reduces the growth of total factor productivity to 0.59 per cent. The difference of 0.82 per cent is the labour quality effect, or product of the labour share and the quality index. For a labour share in value added of

Table 2.3 Labour quality change in the United States private domestic economy 1947-1974 (annual per cent).

	(1) Labour quality	(2) Total hours	(3) Labour input
1947-1951	1.12	0.59	1.71
1951-1955	0.85	0.29	1.14
1955-1959	0.60	0.29	0.89
1959-1963	1.27	-0.03	1.24
1963-1967	-0.23	2.54	2.31
1967-1971	0.58	0.26	0.84
1971-1974	0.12	2.55	2.67
1947-1974	0.60	0.86	1.46

Source: Chinloy (1980, Table 4, p. 115).

60 per cent the index of labour quality grows at 1.38 per cent annually. This arises since the effect is the product of the share and quality index. Estimates on the growth of quality change appear to diverge substantially, dependent on what factors are included in the index.

2.3 Issues in the Measurement of Labour Quality

It appears that in Canada and the United States, the recent decline in productivity growth does not stem from a decline in labour quality, although both have occurred in the 1970's. The conclusion is tentative because of the incomplete time series used and the various specifications of functional form. The literature indicates a series of leading and largely unresolved issues in the measurement of labour quality. Some of the more dominant are:

2.3.1/ Selection of Functional Form

Labour quality is derived from an aggregate of labour input. If there are N types of labour, this input index is the product of hours worked in total and an index reflecting these N categories. In his construction of indices for labour quality, Denison (1979) relies on multiplication of separate effects for education, age and sex and class of worker. This ignores interactive effects between the included factors, and may to lead to errors in measurement. Flexible functional forms for the labour subaggregate are to be preferred, given their correspondence with index numbers.

Frequently, incomplete time series obtain, in which case there is an alternate specification for the labour quality index. Suppose earnings for various groups are available for a census year. A Laspeyres quality index of labour quality is constructed, using the available data. The issue of aggregation error may be less substantial given the negligible difference in index numbers yielded by various flexible functional forms.[9]

2.3.2/ Use of Wages to Reflect Marginal Productivity

Throughout the examination of labour quality, wages have been equated to marginal productivities. This includes treatment of factors such as sex, race and age, where there is evidence that at least part of observed wage differentials do not represent productivity gains. If part of the observed male-female wage gap is attributable to discrimination, then that part must be excluded from quality change calculations. While there has been discussion of this, no revised series have been reported. The argument may be extended to education, where demand for credentials per se as opposed to learning is regarded as discriminatory.

Related to this are two other considerations. First, wages are not necessarily at equilibrium levels. Any process of adjustment to market conditions may involve wages temporarily above or below equilibrium. Second, there is the possibility of a deviation between wage and marginal product even for data by age. If workers

have long term contracts involving training, the marginal product profile is more steeply upward sloping that the wage profile. Younger workers are paid more than their marginal product, and this is recouped later. An alternative hypothesis posits the reverse. For jobs offering long term stability, such as in regulated industries or the public sector, potential recruits invest by accepting a wage below the marginal product, and obtain a return later.

In order to identify some of these hypotheses, more information is required than is in the census data. Ability data are also required, as is expected duration of employment.

Suppose women on average earn less than men. Adjusting total hours for the increasing share worked by women yields a value of the labour quality index less than unity. Here unity represents the level if all hours were worked by homogeneous labour, and men and women were of equal productivity. The hypothesis of equal productivity is not testable if discrimination is present and cannot be measured. The use of a wage-weighted quality index will bias labour quality and labour input downward. If the female hours share is growing, the growth of the labour quality index will be lower, and possibly more negative than the true case. The contribution of labour quality change to a productivity slowdown is overstated. It is therefore possible that even the relatively small role assigned

to labour quality in explaining the productivity slowdown is too large.

2.3.3/ Importance of Labour Quality

It may be argued that labour quality examination itself may not solve the productivity puzzle, given the extensive evidence that the effect of the former on the latter has been small. What is unknown is whether the labour quality effect is small because of measurement or specification error, or because of truly exogenous factors.

2.3.4/ Examination of Sectors Other Than Manufacturing

Estimates on productivity and labour quality in Canada have been constructed extensively for both one and two digit manufacturing sectors. It remains to be determined whether manufacturing is typical of the Canadian economy as a whole. May and Denny (1978) and Ostry and Rao (1980), as also Rao (1979) find evidence that labour quality change has had little effect on productivity change in postwar Canadian manufacturing. This observation is to be examined further.

Chapter 3. Labour Input Indexing

3.1 Introduction

A structure is required to derive estimates of labour input and labour quality per hour worked. Labour quality is constructed from two alternative data structures. The establishment payroll survey yields information by region and industry. The household data are classified into sex, age, region, education and occupation.

The production structure necessary to undertake the decomposition is derived. Commencing with the production of output from labour and non-labour inputs, labour input indices are obtained. It is shown how the shifts from one industry or region to another can be measured. Labour input in growth form is the sum of total hours and labour quality effects. The contribution of regional shifts to labour input growth can be determined. The labour input and quality measures are then embedded in a productivity framework, to indicate how they may be integrated with other factors such as capital and raw materials productivity and returns to scale.

3.2 Aggregation of Labour Input

Production occurs from the services of labour and non-labour inputs. An aggregate of output, weakly separable from the labour and non-labour inputs, is assumed to exist.[1] For the labour inputs of interest, an aggregate exists if the relative wage of any pair is independent of the level of non-labour inputs.

The labour market is assumed to operate efficiently, with the marginal product equal to the wage. The production function is, at time t

$$(1) \qquad y_t = y_t(z_t, x_{1t},\ldots,x_{Mt},t)$$

where y_t represents output, z_t labour input and $x_{1t},\ldots,x_{Mt}$ the services of non-labour inputs.[2] The labour subaggregate is

$$(2) \qquad z_t = f(h_{1t},\ldots,h_{Nt})$$

where h_{nt}, n = 1,..., N denotes hours worked by type n labour. As an example, if there are A age groups and E education groups, then N = AE is the number of types of labour.

Total hours worked are

$$(3) \qquad m_t = \sum_{n=1}^{N} h_{nt}$$

and if all workers are homogeneous, contributing identical services per hour worked, $m_t = z_t$. If labour markets are efficient and f is linearly homogeneous

$$(4) \qquad \frac{\partial \ln z_t}{\partial t} = \sum_{n=1}^{N} s_{nt} \frac{\partial \ln h_{nt}}{\partial t}$$

where

$$(5) \quad s_{nt} = \partial \ln f / \partial \ln h_{nt} \qquad n=1,\ldots,N$$

$$= w_{nt}h_{nt} \Big/ \sum_{n=1}^{N} w_{nt}h_{nt}$$

is the share of the nth category of labour in total compensation. The user cost, or wage plus supplementary benefits for this type is w_{nt} with total compensation $w_{nt}h_{nt}$.

The growth of total hours worked in (3) is

$$(6) \quad \frac{\partial \ln g_t}{\partial t} = \sum_{n=1}^{N} b_{nt} \frac{\partial \ln h_{nt}}{\partial t}$$

where $b_{nt} = h_{nt}/g_t$ is the share of the total hours worked by type n labour. Average labour quality is

$$(7) \quad a_t = z_t/g_t$$

and its growth rate is

$$(8) \quad \frac{\partial \ln a_t}{\partial t} = \sum_{n=1}^{N} (s_{nt} - b_{nt}) \frac{\partial \ln h_{nt}}{\partial t}$$

at time t. The growth of labour quality is $\partial \ln a_t / \partial t$, and is the weighted sum of hours worked for the different categories of labour. The weights are $s_{nt} - b_{nt}$, n=1,...,N or the difference between the share in total compensation and the share in total hours. Suppose there are only two groups, skilled and unskilled labour, with $s_{nt} > b_{nt}$ for the former, and the inequality reversed for the latter. If hours worked for skilled labour are growing more rapidly than those for the unskilled category, $\partial \ln a_t / \partial t > 0$, or labour quality change is positive, a sum of total hours, as in m_t would understate labour input.

The growth of labour input is $\partial \ln z_t / \partial t = \partial \ln g_t / \partial t + \partial \ln a_t / \partial t$, or the sum of growth in total hours and labour quality. It remains to decompose the quality index into effects. Let the labour subaggregate (2) have the translog form

$$(9) \qquad \ln z_t = \alpha_0 + \sum_{n=1}^{N} \alpha_n \ln h_{nt} + 1/2 \sum_{m=1}^{M} \sum_{n=1}^{N} \beta_{mn} \ln h_{mt} \ln h_{nt}$$

where α_n, n=0,...,N and β_{mn}, m,n=1,...,N are parameters and where $\beta_{mn} = \beta_{nm}$. Under linear homogeneity

$$(10) \qquad \sum_{n=1}^{N} \alpha_n = 1 \quad \text{and} \quad \sum_{m=1}^{N} \beta_{mn} = 0, \quad n=1,...,N.$$

Efficiency in the labour market requires equating the compensation share of the n th type with its logarithmic marginal product, or

$$(11) \quad s_{nt} = \alpha_n + \sum_{m=1}^{N} \beta_{nm} \ln h_{mt}$$

where the s_{nt} are defined by (5). The conditions of symmetry and linear homogeneity, together with (9) and (11) imply

$$(12) \quad d_t = \sum_{n=1}^{N} v_{nt} \Delta \ln h_{nt}$$

for the logarithmic first difference $d_t \equiv \Delta \ln z_t$ where Δ denotes the first difference operator and $v_{n,t} = 1/2(s_{n,t} + s_{n,t+1})$. This is the growth rate of the translog or Tornqvist index of labour input.[3] The use of the first difference operator permits the application of these procedures to discrete data. The growth of hours worked in discrete time is

$$(13) \quad h_t = \Delta \ln g_t$$

and the growth rate for quality change is

$$(14) \quad q_t = d_t - h_t,$$

or rearranging, $d_t = q_t + h_t$ with the growth of labour input being the sum of labour quality and hours effects.

3.3 Industry and Region Effects: Payroll Data

It is possible to measure inter-industry and inter-regional shifts in employment. These are amenable to testing with payroll data. These are the characteristics that can be obtained from the Employment, Earnings and Hours survey. Let region and industry respectively be indexed by i=1,...,I and r=1,...,R, with I·R categories in total.

Labour input growth, deleting the time subscript is

$$(15) \quad d = \sum_{i=1}^{I} \sum_{r=1}^{R} v_{ir} \, \Delta \ln h_{ir}$$

where v_{ir} is the labour compensation share in the i th industry and r th region, with corresponding hours worked h_{ir}.[4]

The share of total labour compensation in the i th industry is $v_i = \sum_{r=1}^{R} v_{ir}$, summing over region. For this partial index, wage differentials between industries are permitted, but not regional differentials.

Then

$$(16) \quad d_I = \sum_{i=1}^{I} v_i \, \Delta \ln \sum_{r=1}^{R} h_{ir}$$

summing unweighted total hours worked over regions. This is termed a partial Tornqvist index, for some available information is not used in weighting. Analogous to this construction is the regional formulation

$$(17) \quad d_R = \sum_{r=1}^{R} v_r \, \Delta \ln \sum_{i=1}^{I} h_{ir}$$

where d_I and d_R are labour input indices taking respective account of industry and region only. The growth rates in d_I and d_R are subaggregates of labour input.

For the partial Tornqvist index (16), the inter-industrial shift effect is

$$(18) \quad q_I = d_I - h.$$

Hence (18) is a nested, restrictive form of the growth rate q which included both industry and region effects. For the regions

$$(19) \quad q_R = d_R - h$$

and using both industry and region

$$(20) \quad q = d - h.$$

So q includes both inter-industry and inter-region effects, when data on all industries are available in each region. The growth rate (18) is the industry effect, or contribution to labour input of shifts between industries. The rate in (19) is the regional effect, or the contribution of allocating labour toward relatively high wage areas of the country. The interactive effect is

$$(21) \quad q_{IR} = (\dot{d} - h) - (\dot{d}_I - h) - (\dot{d}_R - h)$$
$$= \dot{d} - h - q_I - q_R$$

or the joint effect of industry and region less the effects of each separately. Hence

$$(22) \quad q = q_I + q_R + q_{IR}$$

and labour input is

$$(23) \quad \dot{d} = h + q_I + q_R + q_{IR}$$

all in growth forms. The importance of (22) and (23) is that labour input growth is decomposed into a number of contributory factors associated with region and industry.

3.4 Education, Age, Sex and Region Effects: Household Data

A similar structure applies to the household model. Here, there are sex, age, education and region effects. Occupational data are

available, but only for the 1971 and not the 1976 Census. The labour input index in growth form is

$$(24) \quad d_{saer} = \sum_{s=1}^{2} \sum_{a=1}^{A} \sum_{e=1}^{E} \sum_{r=1}^{R} v_{saer} \Delta \ln h_{saer}$$

for discrete data. The subscript s applies to sex, a to age, e to education and r to region, with levels A, E and R respectively in the last three cases. Hours worked in a given sex, age, education and region category are h_{saer} with compensation share v_{saer}.

Total hours worked are

$$(25) \quad M = \sum_{s=1}^{2} \sum_{a=1}^{A} \sum_{e=1}^{E} \sum_{r=1}^{R} h_{saer}$$

with growth rate $\Delta \ln g$. Labour quality growth is

$$(26) \quad q_{saer} = d_{saer} - h$$

and includes the effects of sex, age, education and region.

One way effects of each characteristic can be constructed by summing over the remaining three. The quality effect of sex, as an upper bound, is

$$(27) \quad q_s = \sum_{s=1}^{2} v_s \Delta \ln h_s - \Delta \ln g$$

where v_s is the share of each sex in total compensation,

$$v_s = \sum_{a=1}^{A} \sum_{e=1}^{E} \sum_{r=1}^{R} v_{saer}.$$

Hours worked by each sex are $h_s = \sum_{a=1}^{A} \sum_{e=1}^{E} \sum_{r=1}^{R} h_{saer}$.

Change in sex composition affects labour quality only in so far as wages reflect marginal products. Walters (1968) has used these in the Canadian context, and Denison (1974) has constructed such measures for the United States. If part of the wage differential is attributable to discrimination, then the sex effect q_s is overstated. The age effect is

$$(28) \quad q_a = \sum_{a=1}^{A} v_a \, \Delta \ln h_a - \Delta \ln g$$

where v_a is the compensation share of each age group, and h_a hours worked. Analogous measures for education are

$$(29) \quad q_e = \sum_{e=1}^{E} v_e \Delta \ln h_e - \Delta \ln g$$

with v_e the compensation share of each education group and h_e hours worked, and $v_e = \sum_{s=1}^{2} \sum_{a=1}^{A} \sum_{r=1}^{R} v_{saer}$, $h_e = \sum_{s=1}^{2} \sum_{a=1}^{A} \sum_{r=1}^{R} h_{saer}$.

Finally, the region effect is

$$(30) \quad q_r = \sum_{r=1}^{R} v_r \Delta \ln h_r - \Delta \ln g$$

where v_r and h_r are analogously defined.

This implies that labour quality can be expressed as the sum of the four first order effects $q_s + q_e + q_a + q_r$ plus an interactive effect q_i.

3.5 Labour Input, Labour Quality and Aggregate Productivity Growth

It remains to indicate how proposed measures of labour input and quality change are integrated with the performance of aggregate productivity. This permits the use of these estimates with a larger study of productivity change in Canada.

The labour subaggregate, given linear homogeneity and deleting time, is

$$(31) \qquad a = gf(h_1/g,\ldots,h_N/g) = ge(h_1,\ldots,h_N)$$

where e is the labour index. In growth form, lna = lng + lne.

Substituting in (1), the underlying production function is

$$(32) \qquad y = y(ge(h_1,\ldots,h_N),\ x_1,\ldots,x_M,t)$$

with the list $x_1,\ldots,x_M$ possibly including intermediate inputs, fuels and raw materials. Normalizing the production function, also linearly homogeneous, in quantities by total hours worked g

$$(33) \qquad y/g = y^*(e(h_1,\ldots,h_N),\ x_1/g,\ldots,x_M/g)$$

where y/g is output per hour or labour productivity, as defined in

widely published Statistics Canada series. Labour productivity is dependent on labour quality $e(h_1,\ldots,h_N)$, intensity of usage per hour of non-labour inputs $x_1/g,\ldots,x_M/g$, and time t normalized by hours. Intensity of usage can include machine hours of various categories used per hour, or capital-labour ratios, and raw materials and fuels used per hour. Alternatively, if time is separable from both the gross outputs in y and the labour and non-labour inputs, then time is not normalized by hours worked.[7]

Differentiating (32) in logarithms totally

$$(34)\quad \frac{d\ln y}{dt} = \frac{\partial \ln y}{\partial \ln z}\left[\partial \ln g/\partial t + \partial \ln e/\partial t\right] + \sum_{m=1}^{M} \frac{\partial \ln y}{\partial \ln x_m}\frac{\partial \ln x_m}{\partial t} + \frac{\partial \ln y}{\partial t}$$

but in equilibrium $\partial \ln y/\partial \ln z$ is the share of labour inputs in the value of gross product. This share is $\sum_{i=1}^{N} w_i h_i/py$ where w_i is the user cost of the ith category of labour and p is the price of output. Also $\partial \ln y/\partial \ln x_m$ is the share of the mth type of non-labour input in the value of gross output $b_m x_m/py$ where b_m is the price of category m. Designate these shares as s_i, $i=1,\ldots,M+N$, with $s_z = \sum_{i=M+1}^{M+N} s_i$ being the share of labour, and the first M inputs labelled as applying to non-labour.

Using first differencing notation and the shares,

$$(35) \quad \Delta \ln y = v_z[\Delta \ln g + \Delta \ln e] + \sum_{i=1}^{M} v_i \, \Delta \ln x_i + \Delta \ln c$$

where $\Delta \ln y = \ln y_t - \ln y_{t-1}$ for discrete data and v_z and v_i are Tornqvist two period arithmetic moving averages of s_z and s_i respectively. Also $\Delta \ln c$ is the growth rate of the shift in the production function over time, or total factor productivity. Subtracting the growth of employment from both sides of (35),

$$(36) \quad \Delta \ln y - \Delta \ln g = v_z \Delta \ln e - (1 - v_z)\Delta \ln g + \sum_{i=1}^{M} v_i \Delta \ln x_i + \Delta \ln c$$

$$= v_z \Delta \ln e + \sum_{i=1}^{M} v_i (\Delta \ln x_i - \Delta \ln g) + \Delta \ln c.$$

Finally, rearranging in terms of total factor productivity

$$(37) \quad \Delta \ln c = \Delta \ln(y/g) - v_z \Delta \ln e - \sum_{i=1}^{M} v_i (\Delta \ln x_i - \Delta \ln g).$$

Total factor productivity growth is labour productivity growth less share weighted labour quality change and share weighted intensity of usage of non-labour inputs $\Delta \ln x_i - \Delta \ln g$, $i=1,\ldots,M$, or

$$(38) \quad \Delta \ln c = \Delta \ln(y/m) - v_z(q_e + q_a + q_s + q_r + q_i) - \sum_{i=1}^{M} v_i \Delta \ln(x_i/m).$$

Hence changes in the labour quality of Canadian employment may be linked directly to productivity growth, whether in labour or total factor productivity. This study does not carry (38) out directly, since the components depend on estimates from other research undertaken in this broader study of productivity. The objective is to show how labour quality may be integrated into an aggregate study of Canadian productivity.

3.6 Labour Quality Measurement: Implications

The theoretical structure above details the construction of estimates of quality change in labour input. Quality change includes the amount of labour services provided per hour or employee, depending on whether total hours or total people employed constitutes employment.

Labour productivity, or output per hour or person employed, is the sum of several contributory factors, of which labour quality is one. The labour productivity growth measure, corresponding exactly to that readily available from Statistics Canada is the sum of:

a. a labour quality effect, the product of the percentage share of labour compensation in the value of gross output and the growth of labour quality and
b. non-labour input effects, the product of the percentage share of each non-labour input, capital or raw materials, in gross output value and the growth of usage per hour or person employed, and

c. a total factor productivity effect, or the growth of the residual, or output per unit of all inputs.

Consider economic policies to preserve employment in relatively low wage industries such as textiles. Apart from the potential distortions created by tariff barriers and import quotas, there remains the productivity effect. Increasing the relative employment in low wage industries reduces labour input, by this inter-industry shift, similar to that measured by Denison (1974) and Walters (1968).

Estimates of the contribution of a given factor or characteristic of employment to productivity can also be constructed. Suppose the share of labour in value added is 75 per cent. Then if education contributed 0.6 per cent annually to labour quality growth, as estimated by Christenson, Cummings and Jorgenson (1980), it contributed 0.45 per cent annually to growth in labour productivity.

In turn, a slowdown in the growth of labour productivity can be traced to sources in the labour market. If there is a slowdown in labour productivity growth, as occurred between 1973 and 1982, and no corresponding decline in either the contribution of education to quality change or the share of labour, then shifts in educational attainment are not causal factors in the productivity slowdown.

There is a bias in the measurement of total factor productivity if labour quality is neglected. Total factor productivity is measured as a residual, being the growth of outputs less that of inputs. If labour quality change is positive but neglected, this will appear as part of total factor productivity. Hence total factor productivity growth is biased upward if positive contributors are excluded in the labour input index. Conversely, such growth is biased downward if negative contributors are excluded from the labour input index. Estimates capable of measuring labour quality have been derived, as also their relationship to productivity measures.

On the household side, education policy remains an issue in Canada. If education does not contribute substantially to productivity growth this undermines the large investment made in public educational institutions in Canada. Evidence that there is a relatively large contribution to productivity change from post-secondary education provides a measure of the benefit of investment.

Chapter 4. Data Description

4.1 Establishment Data

The principal source of the payroll data is the Statistics Canada series on Employment, Earnings and Hours (Catalogue 72-002). The physical sources are the data banks from CANSIM. Separate data are constructed for employment, average weekly wages and average hourly wages.

The data on industry and region are obtained from a payroll survey. The employment data cover firms with twenty or more employees, as obtained from the Establishment Survey, Labour Division, Statistics Canada. Coverage rates of the survey vary across industries, as Ostry and Rao (1980) have pointed out.[1] The data list the number of jobs filled by establishment.

Average weekly wages are obtained by dividing the total weekly payroll by the total number of jobs filled.[2] These are constructed by Statistics Canada separately for wage earners and salaried employees. Average hourly earnings are obtained by dividing total weekly wages of hourly rated wage earners by total weekly hours. Overtime is included in hours.

Also hours refer to those paid rather than those worked. Multiple job holders working at least seven hours per week on more than one payroll job are counted more than once. Hours paid but not worked such as time for vacation and sick leave are counted in the hours paid series. Establishment data remain the sole method of linking data on the labour market with those in the national accounts. This linkage is essential for the construction of productivity measures.

The economy is divided into five regions, the Atlantic Provinces, Quebec, Ontario, the Prairies and British Columbia. The industrial classification is essentially on a two digit basis. The total number of industries used is seventeen, for the five groupings.

Each of these series on total employment and average weekly wages is a CANSIM data matrix. Each matrix is a monthly time series from January 1961 - March 1980 or 231 observations. The complete classification for a given industry over region then contains 1155 data points. Total compensation or payroll is reconstructed first, by multiplying together total employment by average weekly earnings. So

(39) $$COMP(IND, IR) = AWW(IND, IR) * EMP(IND, IR)$$

where the arrays COMP, AWW and EMP pertain respectively to industry and region, and IND and IR are the industry-region indicators. From

the COMP series are constructed the moving average labour shares, and then the procedure as described is developed.

4.2 Household Census Data

The classification used contains on the household side four characteristics of labour. These are summarized in Table 4.1. For the 1971 and 1976 Census data, off the microdata original tapes, counts of total employment by sex, region, age and education are obtained. Each individual is given a code with a number corresponding to each characteristic. For example, a person who is male, living in Newfoundland, is 17 years old, worked in 1971 and has no schooling, is assigned to the sex = 1, region = 1, age = 1, education = 1 cell.

The employment and earnings data for the 1971 Census are also distinguished by occupation. These occupational categories, at the one digit level are presented in Table 4.2 and there are nine individual types. For the 1971 data, employment and earnings include a classification for the full 3,240 cells representing the two sexes, five regions, six education groups, six age groups and nine occupations. In the 1/100 data sample, there are initially 70,220 observations. These are allocated on an individual basis to the 3,240 cells. For the labour quality growth calculations over the period 1971-1976 only the 360 cell classification by sex, age, education and region is used.

Table 4.1 Classification of Labour, Household Census Data[a]

	Sex		Region
1	Male	1	Atlantic Provinces (Newfoundland, Nova Scotia, New Brunswick, Prince Edward Island)
2	Female	2	Quebec
		3	Ontario
		4	Prairies (Alberta, Saskatchewan, Manitoba)
		5	British Columbia
	Age (Years)		Education[b] (Highest level attended)
1	15 - 19	1	No schooling
2	20 - 29	2	Grade school (Grades 0-8)
3	30 - 39	3	Junior high school (Grades 9-10)
4	40 - 49	4	Senior high school (Grade 13)
5	50 - 64	5	Some University
6	65 or older	6	University degree completed and above

[a]Numbers refer to codes used in data base. Classification on sex, region, age and education applies to 1971-1976. For 1961, only region and sex classifications apply.

[b]For education, grade school includes all those with attended schooling up to grade 8. The some university category includes only those who attend a univrsity without graduating.

Table 4.2 Occupational Classification, Household Census Data

1. Managerial, administrative and related occupations.
2. Occupations in natural sciences, engineering and mathematics; social sciences and related; religion, teaching and related.
3. Occupations in medicine and health; artistic, literary, recreation and related.
4. Clerical and related occupations.
5. Sales occupations.
6. Services occupations.
7. Farming, horticultural and animal husbandry occupations; other primary occupations.
8. Processing occupation; machining and product fabrication, assembling and repairing; construction trades.
9. Transport equipment operating; other occupations.

Complete earnings information on the 360 cell detail is available in 1971 but not in 1976. The earnings data in the 1971 Census pertain to 1970. The earnings of each person in the 1971 Census are assigned by cell to each of the categories. This is performed for all individuals. This yields total compensation and total employment by each group.

The totals for employment and compensation are then scaled upward by a multiplier reflecting the size of sample. If the detailed earnings and employment data are based on a 1 in 100 sample, the series are multiplied by 100. This yields total employment by sex, age, education and region. Let these respectively for 1971 and 1976 be designated HEMP71 (IS, IR, IA, IE) and HEMP76 (IS,IR, IA, IE). The arguments respectively denote sex, region, age and education. Also, total compensation is COMP71 (IS, IR, IA, IE), this being available only in 1971.

The compensation share in each category is

(40) SHR71 (IS,IR,IA,IE) = COMP71 (IS,IR,IA,IE)/COMP

where COMP is earnings of all those employed. For 1976, compensation data are constructed by multiplying the average earnings by cell in 1971 by EMP76. This yields COMP76, and the compensation shares COMP76 are constructed analogously to (40).

Analogously, shares in total employment SEMP71 and SEMP76 by category are defined. These correspond respectively to s_{nt} and b_{nt} in (8). Using the arithmetic share weight on employment, the weight for 1971-1976 is (SEMP71 + SEMP76)/2. The compensation weight is (COMP71 + COMP76)/2. Hence, $s_{71,76}$ = (COMP1 + COMP2)/2 and $b_{71,76}$ = (SEMP71 + SEMP76)/2.

The labour quality growth rate, using weights for sex, age, education and region, for 1971-1976 is

$$(41)\quad a_{71,76} = \sum_{IS=1}^{2} \sum_{IR=1}^{R} \sum_{IA=1}^{A} \sum_{IE=1}^{E} [s_{71,76}(IS,IR,IA,IE) - b_{71,76}(IS,IR,IA,IE)]^* [LN(EMP76(IS,IR,IA,IE)) - LN(EMP71(IS,IR,IA,IE))].$$

Individual effects for each of the 360 cells can also be calculated.

Chapter 5. Empirical Results

5.1 Introduction

The empirical results are divided into three sections. The first section reports on the estimates of labour input change for 1961-1979, on both a quarterly and annual basis. These include the inter-industry and inter-regional shift effects. These are analogous to the measures reported by Walters (1968) and Denison (1974). These estimates are based on Employment, Earnings and Hours payroll data.

The section second details the effects of sex, age, education and region on labour quality, using Census data. Data are constructed only for 1971-1976, given that Census information is not available including earnings for this classification, for years prior to 1971. Details are presented on the labour quality change arising from these four sources, and for each effect singly. This permits measurement of the contribution of education to growth in productivity, and that of each schooling level.

The third section reports on the five factor classificaton by sex, age, education, occupation and education for 1971. This is for all 3,240 cells. Labour quality is the product of a quality

weight and the growth of employment. The former is the difference between the shares in compensation and employment. If this can be assumed to be relatively stable over time, multiplication by employment projections yields labour quality projections. In turn, the effects of occupational and skill shifts on productivity can be computed.

5.2 Industry and Region Shifts

Total employment by region and industry is indicated for a sample month, for the classification used in Table 5.1 and total compensation in Table 5.2. The industries are selected on a mutually exclusive basis, and these are those containing continuous time series over 1961-1979.

In Table 5.3 are indicated growth rates for labour input, total employment and the industry-region shift effect on a quarterly basis 1961-1979. In the first quarter of 1961, labour input declines by 0.84 per cent. Total employment declines by 0.70 per cent, and the industry-region shift is -0.14 per cent. Table 5.4 presents the same data on an annual basis. The industry classification is not complete, because of the absence of a continuous time series.

Table 5.1 Total Employment by Industry and Region - Canada '000, February, 1978

Industry	Atlantic	Quebec	Ontario	Prairies	British Columbia
Construction	10.0	37.7	70.3	38.3	16.7
Finance & Real Estate	18.9	81.8	152.6	49.5	37.6
Forestry	5.2	7.5	7.9	3.0	16.1
Manufacturing	69.5	433.2	763.1	113.1	124.7
Mining Including Milling	12.2	21.5	28.9	46.3	13.2
Services	24.4	111.5	223.1	91.7	57.9
Trade	56.7	171.6	332.0	142.3	84.2
Transportation and Communication	59.2	174.6	222.3	127.0	88.7

Table 5.2 Weekly Labour Compensation by Industry and Region, in $'000, Canada, February 1978

Industry	Atlantic	Quebec	Ontario	Prairies	British Columbia
Construction	3,013.40	14,929.95	25,837.36	14,353.68	7,393.75
Finance & Real Estate	4,046.30	20,161.24	37,654.04	11,742.88	9,366.53
Forestry	1,236.77	2,253.97	977.04	6,061.16	6,061.16
Manufacturing	17,219.31	112,822.50	219,810.94	30,803.92	41,170.93
Mining Including Milling	3,630.11	7,385.03	10,090.13	18,627.41	5,018.37
Services	3,504.08	20,979.84	40,046.45	15,113.07	10,906.04
Trade	9,591.93	35,150.54	64,192.15	27,895.06	19,388.73
Transportation and Communication	16,424.43	53,450.27	68,628.44	38,256.21	29,938.91

Source: Statistics Canada, Employment, Earnings and Hours (Catalogue 72-002), Ottawa, Ontario, Statistics Canada.

Table 5.3 Growth Rates, Labour Input, Total Employment and Industry-Region Shift Effects, Quarterly 1961-1979

Year and Quarter	Labour Input	Total Employment	Industry-Region Shift Effect
1961:1			
1961:2	-0.0084		
1961:3	0.1288	-0.0070	
1961:4	0.0205	0.0841	-0.0014
	-0.0738	0.0130	0.0447
1962:1		-0.0461	0.0076
1962:2	-0.0311		0.0277
1962:3	0.1243	-0.0252	
1962:4	0.0166	0.0812	0.0059
	-0.0814	0.0101	0.0431
1963:1		-0.0513	0.0065
1963:2	-0.0303		0.0301
1963:3	0.1174	-0.0238	
1963:4	0.0305	0.0770	-0.0065
	-0.0655	0.0197	0.0404
1964:1		-0.0406	0.0108
1964:2	-0.0183		0.0249
1964:3	0.1174	-0.0148	
1964:4	0.0315	0.0760	0.0035
	-0.0612	0.0206	0.0414
1965:1		-0.0381	0.0110
1965:2	-0.0009		0.0231
1965:3	0.1136	-0.0036	
1965:4	0.0311	0.0746	0.0027
	-0.0441	0.0199	0.0390
1966:1		-0.0263	0.0112
1966:2	-0.0104		0.0178
1966:3	0.1207	-0.0084	
1966:4	0.0064	0.0781	-0.0019
	-0.0622	0.0031	0.0426
		-0.0360	0.0032
			-0.0262

Table 5.3 (cont'd) Labour Input Quarterly (Sums) - Canada, 1961 to 1980

Year and Quarter	Labour Input	Total Employment	Industry-Region Shift Effect
1967:1	-0.0172	-0.0143	-0.0029
1967:2	0.0817	0.0548	0.0269
1967:3	0.0070	0.0045	0.0025
1967:4	-0.0736	-0.0439	-0.0297
1968:1	-0.0263	-0.0205	0.0058
1968:2	0.0838	0.0540	0.0297
1968:3	0.0275	0.0174	0.0101
1968:4	-0.0560	-0.0328	-0.0232
1969:1	0.0023	-0.0009	0.0032
1969:2	0.0909	0.0597	0.0313
1969:3	0.0019	0.0007	0.0012
1969:4	-0.0479	-0.0296	0.0183
1970:1	-0.0253	-0.0182	-0.0071
1970:2	0.0647	0.0425	0.0222
1970:3	0.0031	0.0003	0.0028
1970:4	-0.0569	-0.0338	0.0231
1971:1	-0.0230	-0.0174	-0.0056
1971:2	0.1060	0.0674	0.0386
1971:3	0.0003	-0.0002	0.0006
1971:4	-0.0759	-0.0448	-0.0311
1972:1	0.0017	0.0000	0.0017
1972:2	0.0742	0.0484	0.0258
1972:3	0.0201	0.0092	0.0108
1972:4	-0.0560	-0.0305	-0.0255

Table 5.3 (cont'd) Labour Input Quarterly (Sums) - Canada, 1961 to 1980

Year and Quarter	Labour Input	Total Employment	Industry-Region Shift Effect
1973:1	0.0152	0.0090	0.0063
1973:2	0.1016	0.0643	0.0374
1973:3	0.0086	0.0041	0.0045
1973:4	-0.0274	-0.0123	-0.0151
1974:1	0.0043	0.0009	0.0034
1974:2	0.0886	0.0575	0.0311
1974:3	0.0032	-0.0013	0.0045
1974:4	-0.0609	-0.0346	-0.0263
1975:1	-0.0389	-0.0276	-0.0113
1975:2	0.0857	0.0552	0.0304
1975:3	-0.0134	-0.0090	-0.0044
1975:4	-0.0440	-0.0262	-0.0177
1976:1	0.0066	0.0026	0.0040
1976:2	0.0790	0.0489	0.0302
1976:3	-0.0161	-0.0106	-0.0055
1976:4	-0.0409	-0.0240	-0.0169
1977:1	-0.0213	-0.0158	-0.0055
1977:2	0.0884	0.0543	0.0340
1977:3	-0.0105	-0.0076	-0.0029
1977:4	-0.0607	-0.0337	-0.0270
1978:1	-0.0055	-0.0034	-0.0021
1978:2	0.0869	0.0539	0.0331
1978:3	0.0010	0.0003	0.0007
1978:4	-0.0462	-0.0243	-0.0219

Table 5.3 (cont'd) Labour Input Quarterly (Sums) - Canada, 1961 to 1980

Year and Quarter	Labour Input	Total Employment	Industry-Region Shift Effect
1979:1	-0.0047	-0.0046	-0.0001
1979:2	0.0940	0.0573	0.0367
1979:3	0.0020	0.0015	0.0005
1979:4	-0.0505	-0.0284	-0.0221

Table 5.4 Growth Rates, Labour Input, Total Employment and Industry-Region Shift Effects, 1961 - 1979 Annually

Year	Labour Input	Total Employment	Industry-Region Shift Effect
1961	0.0671	0.0440	0.0232
1962	0.0284	0.0147	0.0137
1963	0.0521	0.0323	0.0198
1964	0.0694	0.0436	0.0258
1965	0.0997	0.0646	0.0350
1966	0.0545	0.0367	0.0177
1967	-0.0020	0.0011	-0.0031
1968	0.0290	0.0182	0.0109
1969	0.0472	0.0298	0.0174
1970	-0.0144	-0.0092	-0.0052
1971	0.0075	0.0051	0.0024
1972	0.0399	0.0272	0.0127
1973	0.0981	0.0650	0.0330
1974	0.0353	0.0226	0.0128
1975	-0.0106	-0.0076	-0.0030
1976	0.0286	0.0169	0.0118
1977	-0.0042	-0.0028	-0.0014
1978	0.0362	0.0264	0.0098
1979	0.0408	0.0259	0.0149

The results in the last column of Table 5.4 indicate a slowdown in the industry-region shift. In 1961, this shift in employment contributes 2.32 per cent to raising labour input per employed person. During the 1960's, this industry-region shift averages almost 2 per cent. During the 1970's this shift effect declines almost to an average of 1 per cent. In the period since 1973, the industry-region effect has growth rates of 1.28 per cent for 1974, -0.30 per cent in 1975, 1.18 per cent in 1976, -0.14 per cent in 1977, 0.98 per cent in 1978 and 1.49 per cent in 1979. The total is 4.49 per cent over six years, or 0.75 per cent annually. In no year over 1961-1966 is such a low estimate obtained, and the lowest estimate for this period is 1.37 per cent.

Table 5.5 provides a decomposition of this industry-region shift effect on a quarterly basis. There is a regional effect, an industrial effect and a joint interaction effect. In Table 5.6 is the decomposition presented on an annual basis. The results indicate that the regional effect is the more dominant. In the period since 1973, the regional shifts in employment between the Maritimes, Quebec, Ontario, the Prairies and British Columbia also are reduced. These percentage contributions are 1.09 per cent in 1974, -0.34 in 1975, 0.93 in 1976, -0.14 in 1977, 1.33 in 1978 and 1.39 per cent in 1979, or cumulatively 4.26 per cent, for an average of 0.71 per cent. The results

Table 5.5 Decomposition of Labour Input Growth in Canada by Industry and Region, 1971-1979, Quarterly

Year and Quarter	Labour Input Growth	Industry-Region Shift	Total Employment Growth	Regional Shift	Industrial Shift	Interactive Shift
1971:1	-0.0230	-0.0056	-0.0174	-0.0083	0.0377	-0.0350
1971:2	0.1060	0.0386	0.0674	0.0318	-0.0019	0.0087
1971:3	0.0003	0.0006	-0.0002	0.0005	0.0042	-0.0042
1971:4	-0.0759	-0.0311	-0.0448	-0.0212	-0.0415	0.0316
1972:1	0.0017	0.0017	0.0000	0.0009	0.0330	-0.0322
1972:2	0.0742	0.0258	0.0484	0.0212	0.0050	-0.0004
1972:3	0.0201	0.0108	0.0092	0.0063	0.0100	-0.0054
1972:4	-0.0560	-0.0255	-0.0305	-0.0141	-0.0390	0.0276
1973:1	0.0152	0.0063	0.0090	0.0051	0.0351	-0.0339
1973:2	0.1016	0.0374	0.0643	0.0310	0.0111	-0.0047
1973:3	0.0086	0.0045	0.0041	0.0019	0.0144	-0.0117
1973:4	-0.0274	-0.0151	-0.0123	-0.0051	-0.0350	0.0250
1974:1	0.0043	0.0034	0.0009	0.0012	0.0207	-0.0185
1974:2	0.0886	0.0311	0.0575	0.0267	0.0178	-0.0133
1974:3	0.0032	0.0045	-0.0013	0.0001	0.0029	0.0016
1974:4	-0.0609	-0.0263	-0.0346	-0.0170	-0.0677	0.0585
1975:1	-0.0389	-0.0113	-0.0276	-0.0132	0.0341	-0.0321
1975:2	0.0857	0.0304	0.0552	0.0267	-0.0004	0.0042
1975:3	-0.0134	-0.0044	-0.0090	-0.0075	-0.0106	0.0137
1975:4	-0.0440	-0.0177	-0.0262	-0.0093	-0.0192	0.0108
1976:1	0.0066	0.0040	0.0026	0.0019	0.0358	-0.0337
1976:2	0.0790	0.0302	0.0489	0.0231	0.0057	0.0014
1976:3	-0.0161	-0.0055	-0.0106	-0.0045	-0.0012	0.0002
1976:4	-0.0409	-0.0169	-0.0240	-0.0111	-0.0517	0.0460

Table 5.5 (con't) Decomposition of Labour Input Growth in Canada by Industry and Region, 1971-1979, Quarterly

Year and Quarter	Labour Input Growth	Industry-Region Shift	Total Employment Growth	Regional Shift	Industrial Shift	Interactive Shift
1977:1	-0.0213	-0.0055	-0.0158	-0.0071	0.0346	-0.0330
1977:2	0.0884	0.0340	0.0543	0.0258	0.0078	0.0004
1977:3	-0.0105	-0.0029	-0.0076	-0.0033	0.0008	-0.0003
1977:4	-0.0607	-0.0270	-0.0337	-0.0168	-0.0416	0.0314
1978:1	-0.0055	-0.0021	-0.0034	-0.0004	0.0241	-0.0259
1978:2	0.0869	0.0331	0.0539	0.0252	0.0161	-0.0083
1978:3	0.0010	0.0007	0.0003	0.0001	-0.0018	0.0024
1978:4	-0.0462	-0.0219	-0.0243	-0.0116	-0.0342	0.0239
1979:1	-0.0047	-0.0001	-0.0046	-0.0017	0.0253	-0.0238
1979:2	0.0940	0.0367	0.0573	0.0276	0.0233	-0.0142
1979:3	0.0020	0.0005	0.0015	0.0012	-0.0074	0.0066
1979:4	-0.0505	-0.0221	-0.0284	-0.0133	-0.0401	0.0312

Table 5.6 Decomposition of Labour Input Growth in Canada by Industry and Region, 1971-1979, Annually

Year	Labour Input Growth	Industry-Region Shift	Total Employment Growth	Regional Shift	Industrial Shift	Interactive Shift
1961	0.0671	0.0232	0.0440	0.0213	-0.0247	0.0266
1962	0.0284	0.0137	0.0147	0.0087	-0.0046	0.0095
1963	0.0521	0.0198	0.0323	0.0165	0.0124	-0.0090
1964	0.0694	0.0258	0.0436	0.0225	0.0107	-0.0074
1965	0.0997	0.0350	0.0646	0.0330	0.0222	-0.0201
1966	0.0545	0.0177	0.0367	0.0187	0.0107	-0.0117
1967	-0.0020	-0.0031	0.0011	0.0009	-0.0212	0.0172
1968	0.0290	0.0109	0.0182	0.0101	0.0066	-0.0059
1969	0.0472	0.0174	0.0298	0.0163	-0.0101	0.0111
1970	-0.0144	-0.0052	-0.0092	-0.0043	-0.0191	0.0182
1971	0.0075	0.0024	0.0051	0.0027	-0.0015	0.0012
1972	0.0399	0.0127	0.0272	0.0143	-0.0089	-0.0105
1973	0.0981	0.0330	0.0650	0.0329	0.0255	-0.0253
1974	0.0353	0.0128	0.0226	0.0109	-0.0264	0.0282
1975	-0.0106	-0.0030	-0.0076	-0.0034	0.0039	-0.0035
1976	0.0286	0.0118	0.0169	0.0093	-0.0114	0.0139
1077	-0.0042	-0.0014	-0.0028	-0.0014	0.0015	-0.0015
1078	0.0362	0.0098	0.0264	0.0133	0.0043	-0.0078
1979	0.0408	0.0149	0.0259	0.0139	0.0011	-0.0002

indicate that regional movements contribute positively to labour input, and hence to productivity growth. Correspondingly, the industry effects in annual percentage terms are -2.64 in 1974, 0.39 in 1975, -1.14 in 1976, 0.15 in 1977, 0.43 in 1978 and 0.11 in 1979, or -2.70 cumulatively. Hence inter-industry shifts contribute negatively, or -0.45 per cent, indicating increased employment in relatively low wage industries.

The results indicate that there are gains to shifting migration. At the same time, high wage industries have reduced their contribution to employment shifts.

5.3 Labour Quality by Sex, Region, Education and Age

5.3.1 Total Labour Quality

The first result reported on is labour quality change for the period 1971-1976. From the Census, total employment increases from 7,022,500 in 1971 to 9,289,200 in 1976. This increase is 27.97 per cent. However, it is noted that the establishment count of employment differs, increasing from 7.919 million in 1970 to 9.479 million in 1976. Labour quality change is -1.21 per cent. This indicates that quality change, as accounted for by sex, region, education and age, contributes negatively to labour quality over this period. To summarize, on an annual

average basis, employment increases 5.59 per cent, and labour quality by -0.24 per cent. Total labour input increases by the sum of the two, or 5.35 per cent. These results confirm that personal and demographic characteristics continue to contribute negatively to labour input growth in Canada. Previous such estimates for the 1950's and 1960's are derived by Walters (1968).

To measure labour quality change over a longer period, estimates including region and sex are constructed for 1961-1971. Census measured employment in 1961 is 5,097,100. The increase in employment over the period is 32.04 per cent, using the change in logarithms. Shifts in sex and region account for labour quality change of -1.94 per cent. Converting these to annual percentages, the employment increase is 3.20 per cent, and labour quality declines by 0.19 per cent. Total labour input increases by 3.01 per cent.

Over the period 1961-1976, the dominant contributor to labour input growth is total employment. Labour quality exhibits little growth, and actually declines. The comparative aggregate labour quality estimates are indicated in Table 5.7. This indicates that employment growth is more rapid during the 1960's, but the change in labour quality is more negligible.

Table 5.7 Labour Quality and Labour Input, Canada 1961-1976
(Annual Average per cent)

	Labour Input	Employment	Labour Quality
1961-1971 (region-sex)	3.01	3.20	-0.19
1971-1976 (Region-sex-education-age)	5.35	5.59	-0.24

In Table 5.8 are indicated data on total employment and compensation for each of the levels of the factors for 1971 and 1976. Employment is reported in thousands. Also indicated are relative shares. In Table 5.9 are the sources of quality on an average annual per cent basis. Table 5.9 indicates first the total labour quality change, which is the annual average increase for the full cross classification over all 360 cells for 1971-76. Reported below this age the growth rates for each separate single factor index. The region effect of -0.03 per cent is for an index weighting over the relative wages in the five regions only. A similar procedure obtains for the indices by sex, age and education.

The total of the one way effects is the sum of the index contributions of each, or -0.50 per cent annually. The total interactive effects is the difference between the weighted sum for the full sex, age, education and region classification and the four single factor indices.

For the individual sources, the results are reported as the product of the quality effect, or difference between compensation and employment shares for that individual category, and growth in employment. For region, the sum of the five effects is the total contribution of regional shifts to labour quality change.

Table 5.8 Effects on Labour Quality, Canada, 1971-1976

	Employment 1971('000)	Employment 1976('000)	Shares, Proportions Employment 1971	Employment 1976	Compensation 1971
	(1)	(2)	(3)	(4)	(5)
Region-Within					
Maritimes	544	663	0.078	0.071	0.064
Quebec	1,760	2,453	0.251	0.264	0.247
Ontario	2,852	3,568	0.406	0.384	0.430
Prairies	1,115	1,598	0.159	0.172	0.145
British Columbia	751	1,008	0.107	0.109	0.113
Sex-Within					
Male	4,678	5,876	0.666	0.633	0.792
Female	2,345	3,413	0.334	0.367	0.208
Education-Within					
No Schooling	45	40	0.006	0.004	0.004
Some Grade School	1,750	1,717	0.249	0.185	0.221
Some High School	2,445	2,400	0.348	0.258	0.327
High School	1,689	1,569	0.241	0.169	0.237
Some University[b]	550	2,722	0.078	0.293	0.079
Undergraduate degree completed and above	543	841	0.078	0.091	0.132
Age-Within					
15-19	523	876	0.075	0.094	0.019
20-29	2,105	2,784	0.300	0.300	0.247
30-39	1,482	1,985	0.211	0.214	0.251
40-49	1,401	1,713	0.199	0.184	0.245
50-64	1,354	1,717	0.193	0.185	0.220
65 and over	157	214	0.022	0.023	0.018

[a]Quality weight is compensation share less employment share, the latter an arithmetic weighting. Quality effect is quality weight times the growth in employment.

[b]Data for 1971 and 1976 on those with some undergraduate are not comparable. Community college graduates are counted as high school graduates only in the 1971 Census, and as those with some undergraduate in 1976.

Table 5.9 Sources of Labour Quality Growth, Canada 1971-1976
(Annual Average per cent)

Labour quality - Total		-0.24
Region	-0.03	
Sex	-0.36	
Age	-0.36	
Education	0.25	
Total one way effects	-0.50	
Total interactive effects	0.26	
Individual Sources		
Region - Total		-0.03
Maritimes	-0.05	
Quebec	-0.02	
Ontario	0.10	
Prairies	-0.10	
British Columbia	0.04	
Sex - Total		-0.36
Males	0.58	
Females	-0.94	
Age - Total		-0.36
15 - 19	-0.58	
20 - 29	-0.29	
30 - 39	0.23	
40 - 49	0.18	
50 - 64	0.13	
65 and over	-0.03	
Education - Total		0.25
No schooling	0.00	
Some grade school	0.01	
Some high school	0.01	
High school	0.00	
Some university	0.03	
University graduate	0.20	

5.3.2 Region

It remains to assess the individual contributions of each characteristic. Employment grows most rapidly in the Prairies, where the share of the total increases from 15.9 per cent in 1971 to 17.2 per cent in 1976. The quality weight is the difference between the share of compensation and that of employment. These quality weights, the differences between compensation and employment shares, sum to zero.

Among the regions, Ontario has the largest quality weight, the share of total compensation being 2.3 per cent higher than that of employment. The quality effect is the product of the quality weight and the growth in employment. Regional employment shifts in the household sector increase labour quality by 0.1 of one per cent in Ontario over 1971-1976. The only other region to register positive quality change is British Columbia, at 0.4 of one per cent.

The sum of the five entries in the first panel is the joint contribution of regional shifts to labour quality. This amounts to a reduction of three-tenths of one per cent in labour quality. The individual effects in each region of the country are small. The employment growth in Ontario and Western Canada may be relatively concentrated among women and younger workers, but also among the educated.

5.3.3 Sex

Quality change differentials by sex are estimated as an upper bound. If women are paid less because of discrimination or unfavourable networks, the wage differential in the market is not necessarily one based on productivity. At the same time, the results in the second panel indicate the shifts in age, region and education composition of the average male and female worker in Canada 1971-1976. Male employment as a proportion of the total, declines from 66.6 per cent in 1971 to 63.3 per cent in 1976. The share of all employee compensation earned by men is 79.2 per cent.

The quality effect indicates that the labour quality of the average male employed increases by 0.58 per cent as an annual average over the five year period, and that for the average female declines by 0.94 per cent, for a total percentage sex effect of -0.36 per cent annually. Apart from the wage and productivity problem, if increases in female employment are concentrated in nonunion work, a further differential arises.

5.3.4 Education

Regarding education, there is a pronounced shift toward increased employment of graduates. In 1971, 267,000 Canadians employed possessed an undergraduate degree or diploma as highest level of educational attainment. In 1976, this had increased to 615,000. One data problem concerns the classification of

community college graduates. In the 1971 Census these people are counted among the high school graduates, as highest level completed. In 1976, they are included in the some university category. Although the numbers involved are large, as noted in columns (1) and (2), the ultimate effect on labour quality is small.

The quality weight effects show positive values as education increases. If the category of some high school increases in employment, average labour quality for Canada declines. The results indicate that the large contributions to labour quality from education arise at the post-secondary level, a result which has potential policy implications.

The combined undergraduate and postgraduate effects increase labour quality by 0.23 per cent over 1971-1976. The postgraduate sector is also subject to some reclassification between the two census years, so it is more appropriate to consider the two together. Overall, education increases labour quality by 0.25 per cent annually, with almost the entire increase arising from the post-secondary sector.

The results indicate that education contributes a relatively smaller amount to total labour quality, although Walters (1968) has previously indicated similar estimates for the 1950's and 1960's of 0.2 per cent annually. By contrast, up to the early

1970's, estimates for the United States indicate a contribution of 0.6 per cent annually. Christensen, Cummings and Jorgenson (1980) obtain similar estimates for Canada.

More important than the relatively small contribution of education in total is the distribution of effects. There is relatively little contribution from the lower educational sectors. The category of no schooling registers a zero increase over the period. The relative earnings are below average, and if employment were increasing at a below average rate, there would be a positive contribution from reducing the proportion of workers with no schooling. This does not appear to be the case in Canada. In part, this is a statistical aberration. Since those with little education are lower paid, a decrease in employment in this category contributes positively to labour quality. The results suggest that there has been relatively little shift in the proportion of Canadians employed, but with low levels of schooling.

The results do not per se provide an indictment of the high school system. For example, if adult retraining could induce some of those who have not completed high school to do so, the numbers with low educational attainment would be reduced and labour quality increased.

At the university level, there remains the issue of postgraduate education, even despite classification problems in

fields such as law. If there is relatively little productivity gain to postgraduate education over undergraduate, the resources in graduate training may be overallocated.

The conclusions are tempered by substantial reclassification of educational attainment by Statistics Canada. With the 1976 and 1981 Census data consistent, further estimates can be constructed. The basic results suggest:

i. Education increases labour quality by about one quarter of one per cent annually. This is similar to previous estimates for Canada, but below those for previous years in the United States. They do suggest a waning of the contribution of education.

ii. Most of the contribution comes from the university sector, but within this, the effect appears larger in undergraduate education. Clearly, any examination of the social return to educational investment in Canada requires estimates of the labour quality contribution.

5.3.5 Age

Age estimates are presented in the fourth panel. The sum contribution is to reduce labour quality by 0.36 per cent annually as an average over the five years, as younger workers enter employment. Among the 15-19 age group, there is a negative

effect of 0.58 per cent per year over the period, and a further reduction attributable to the 20-29 group of 0.29 per cent. However, these may be viewed as training investments in young workers. Hiring one more teenager reduces average labour quality in Canada, since such a worker is paid less than the average employed person. The worker acquires experience, which may yield a future return. There may be discrimination against younger workers, implying that the wages do not necessarily reflect skill differentials. Wages may also serve the purposes of being positive or negative bonuses. If there is widespread lifetime employment in the economy, these desirable jobs offer a wage in excess of marginal product over a long, tenured period. There is no incentive for workers to produce, and those with wage above marginal product cannot be easily disciplined. The market response is thus to devise a contract where the wage is below the marginal product in the early, probationary period. At the same time, age serves as a proxy for the skill acquisition associated with experience.

Age groups 30-39, 40-49 and 50-64 have positive contributions to labour quality. The 30-39 group increases quality by 1.2 per cent, while the 40-49 age group contributes 0.9 per cent to quality. Increases in employment of these above 65 years of age reduce labour quality.

5.3.6 Concluding Remarks

The complete analysis of sources of quality change in labour input is presented in Table 5.9. The results are presented as annual average percentages. Labour quality change of -0.24 per cent is comprised of effects of region, sex, education and age. These are one way effects, and the interaction between these is 0.21 per cent. Individual sources by region, sex, education and age are also presented.

The following conclusions arise:

i. Regional shifts on the household side generally make small contributions to changes in labour quality. The movement to Western Canada is substantial, but the productivity contribution to labour quality is small but remains positive. Regional effects for Quebec and the Maritimes are small but negligible.

ii. Household characteristics as a whole contribute negatively, but not at magnitudes substantially different from the 1950's and 1960's. Given the rapid decline in productivity growth in the 1970's, it is unlikely that labour quality deterioration can be a contributory factor.

iii. There are substantial impacts from the absorption into employment of young workers and women during the 1971-1976 period. Some of this represents a one time cost associated with demographic shifts.

iv. The contribution of education to labour quality, and ultimately economic and productivity growth is declining. The major contributory factor appears to be among those with little schooling. On the other hand, those with post-secondary education continue to make a large positive contribution, accounting for virtually the entire education effect.

5.4 Occupational and Skill Shifts

The remaining calculation is of occupational and skill shifts in the economy. The quality weight based on the 1971 Census data is $(s_{71} - b_{71})$, the difference between compensation and employment shares. These are presented in Table 5.10, for one way classifications of the factors.

The quality weights for occupation are indicated on a one digit basis. They indicate that managerial workers have a quality weight of 5.09, or the difference is slightly above five percentage points, and this is the largest such. For workers in science and related occupations, the weight is 2.96. Clerical and service workers both exhibit negative quality weights, and are the two largest such categories. Respectively, clerical

Table 5.10 Employment and Quality Weights, 1971, Canada

Index	Employment (100's)	Compensation ($)	Employment Share (%)	Compensation Share (%)	Quality Weight (%)
Region					
Maritimes	5444	2662470	7.7528	6.4373	-1.3155
Quebec	17597	102356000	25.0598	24.7458	-0.3140
Ontario	28517	177667500	40.6109	42.9533	2.3424
Prairies	11151	600382	15.8801	14.5150	-1.3651
British Columbia	7511	469406	10.6964	11.3485	0.6521
Sex					
Male	46773	327463250	66.6092	79.1683	12.5591
Female	23447	861656	33.3908	20.8316	-12.5591
Education					
No Schooling	452	1765650	0.6437	0.4269	-0.2168
Some Grade School	17493	91607000	24.9117	22.1471	-2.7646
Some High School	24454	134691940	34.8248	32.5635	-2.2614
High School	16893	97935250	24.0572	23.6771	-0.3802
Some University	5502	32755910	7.8354	7.9192	0.0838
Undergraduate	2667	24102700	3.7981	5.8271	2.0291
Post Graduate	2759	30770380	3.9291	7.4391	3.5100
Age					
15-19	5237	7679520	7.4580	1.8566	-5.6014
20-29	21053	102258250	29.9815	24.7222	-5.2993
30-39	14821	103726250	21.1065	25.0771	3.9706
40-49	14005	101416880	19.9445	24.5188	4.5743
50-64	13539	91163880	19.2808	22.0400	2.7592
65 and over	1565	7383990	2.2287	1.7852	-0.4435
Occupation					
Managerial	3435	41304330	4.8918	9.9858	5.0941
Science	6373	49797070	9.0758	12.0391	2.9633
Medical	3466	200795	4.9359	4.8545	-0.0814
Clinical	12170	55387270	17.3312	13.3906	-3.9407
Sales	6716	40463440	9.5642	9.7825	0.2183
Service	7843	32941710	11.1692	7.9641	-3.2051
Farming	2835	12328680	4.0373	2.9806	-1.0567
Processing	15335	94636250	21.8385	22.8795	1.0410
Transport	12047	66690500	17.1561	16.1233	-1.0328
Totals	70220	413629000	100.0000	100.0000	0.0000

workers have a -3.94 per cent weight, and service workers a -3.21 per cent weight.

The quality weights can be used in forecasting labour quality under differing scenarios on occupational composition and skill shortages. If all occupational groups grow in employment at a constant rate, the quality effect for occupation is zero, since the quality weights sum to zero. In this case, if q_o is the occupational quality effect,

$$q_o = \sum_{i=1}^{9} (s_{71,i} - b_{71,i}) \Delta \ln h = 0.$$

Shifts of growth toward managerial and scientific personnel have a positive effect on labour input in Canada, and on both labour and total factor productivity.

Suppose the growth of employment in all categories annualized over a given period is 2 per cent, but that for managerial and scientific workers is 4 per cent. The negative occupational effect from the other categories is -0.16 per cent in reducing labour quality annually. However, the managerial group alone contributes 0.20 per cent annually to labour quality, and the scientific group another 0.12 per cent, leading to a positive 0.16 per cent over all occupations. At a labour share in value added of two-thirds, total factor productivity on a value added basis is increased by 0.11 per cent annually by these shifts. On a gross output basis the effect is smaller, since the labour share of gross output is smaller. The results indicate that an increase in employment directed toward skilled occupations has a contributory effect on productivity.

In Table 5.11 the regional and occupational quality weights are detailed. In this and subsequent tables the occupational groups are:

1 Managerial
2 Science
3 Recreational
4 Clerical
5 Sales
6 Service
7 Farming

Table 5.11 Employment and Quality Weights, 1971, Canada

Index	Employment (100's)	Compensation ($)	Employment Share (%)	Compensation Share (%)	Quality Weight (%)
Maritimes					
1	200	1832110	0.2848	0.4429	0.1581
2	509	3302150	0.7249	0.7983	0.0735
3	246	1224830	0.3503	0.2961	-0.0542
4	790	3164080	1.1250	0.7650	-0.3601
5	518	2471080	0.7377	0.5974	-0.1403
6	714	3173210	1.0168	0.7672	-0.2496
7	329	1158870	0.4685	0.2802	-0.1884
8	1152	5651100	1.6406	1.3662	-0.2743
9	986	4649050	1.4042	1.1240	-0.2802
Quebec					
1	927	10860870	1.3201	2.6258	1.3056
2	1624	12263290	2.3127	2.9648	0.6521
3	919	5906780	1.3087	1.4280	0.1193
4	3013	14061230	4.2908	3.3995	-0.8913
5	1557	9781860	2.2173	2.3649	0.1476
6	1792	7406970	2.5520	1.7907	-0.7613
7	462	1912020	0.6579	0.4623	-0.1957
8	4032	22618460	5.7420	5.4683	-0.2737
9	3271	17544530	4.6582	4.2416	-0.4166
Ontario					
1	1474	19237800	2.0991	4.6510	2.5519
2	2579	21968320	3.6727	5.3111	1.6384
3	1354	7932210	1.9282	1.9177	-0.0105
4	5344	25187430	7.6104	6.0894	-1.5210
5	2628	16584910	3.7425	4.0096	0.2671
6	3012	12772570	4.2894	3.0879	-1.2014
7	872	3940350	1.2418	0.9526	-0.2892
8	6530	42833450	9.2993	10.3797	1.0804
9	4724	27110550	6.7274	6.5543	-0.1731
Prairies					
1	517	5628460	0.7363	1.3607	0.6245
2	1052	7532750	1.4981	1.8211	0.3230
3	602	2990320	0.8573	0.7229	-0.1344
4	1824	7602870	2.5976	1.8381	-0.7595
5	1219	6727560	1.7360	1.6265	-0.1095
6	1343	5209380	1.9126	1.2594	-0.6531
7	785	3027780	1.1179	0.7320	-0.3859
8	2026	12318640	2.8852	2.9782	0.0930
9	1783	9000510	2.5392	2.1760	-0.3632

continued...

Table 5.11 (cont'd) Employment and Quality Weights, 1971, Canada

Index	Employment (100's)	Compensation ($)	Employment Share (%)	Compensation Share (%)	Quality Weight (%)
British Columbia					
1	317	3745090	0.4514	0.9054	0.4540
2	609	4730560	0.8673	1.1437	0.2764
3	345	2025460	0.4913	0.4897	-0.0016
4	1199	5371660	1.7075	1.2987	-0.4088
5	794	4898040	1.1307	1.1842	0.0534
6	982	4379580	1.3985	1.0588	-0.3396
7	387	2289660	0.5511	0.5536	0.0024
8	1595	11114680	2.2714	2.6871	0.4157
9	1283	8385970	1.8271	2.0274	0.2003
Totals	70220	413629000	100.0000	100.0000	0.0000

Note: Occupational codes: 1 Managerial, 2 Science, 3 Recreational, 4 Clerical, 5 Sales, 6 Service, 7 Farming, 8 Processing, 9 Transport

8 Processing

9 Transport

The quality weights by skill level are computed on a regional basis. The sum over all region-occupation categories is zero, but not necessarily so within a region. The first case is for the Maritime provinces. Occupational groups 1 and 2, for managerial and science have a positive quality weight, but all others are negative. Uniform growth of employment over occupations in the Maritimes would have a negative effect on labour input and productivity.

In Quebec and Ontario, the quality effects associated with managerial employment are higher. A 1 per cent increase in managerial employment in Quebec raises labour quality by 0.13 per cent in Canada, and the corresponding estimate for Ontario is 0.26 per cent. If labour is two-thirds of value added, this indicates a productivity contribution of 0.17 per cent.

On a gross output basis, if labour compensation is two-fifths of the value of production, increasing managerial employment in Ontario by one per cent increases labour productivity by 0.1 per cent annually.

The sum of the occupational quality weights in Ontario is positive. A uniform increase in employment on a percentage basis in this province raises labour quality in Canada. Of note is the positive quality weight for processing employers. An increase in

manufacturing blue collar employment increases labour quality and measured productivity.

An occupation may have a positive quality effect if regional wages are above the national average. The implication is that employers must ensure a higher marginal product of labour. Shifts in occupational distribution toward higher wage regions is thus a positive productivity effect. Even if wages are higher in a region because of non-competitive forces such as unionization, employers increase productivity to compensate for the wage differential.

In British Columbia, all but three occupations at the one digit level have a positive quality weight. A uniform increase of one per cent in employment across occupations in the province increases labour quality in Canada by 0.065 per cent. Using the two-fifths share in gross output for labour, the effect on labour productivity is to increase it by 0.026 per cent. Total factor productivity growth is measured as a residual. An increase in labour quality reduces the growth of total factor productivity.

On a regional basis, there are differences in the quality weight attributable to occupation. In British Columbia most occupations have a positive weight, implying that employment growth anywhere contributes to national productivity change. For Ontario and Quebec, increases in skilled or high wage employment

contributes positively, while in the Maritimes, the occupational structure is less favourable to growth.

In Table 5.12 is the quality weight configuration by sex and occupation. For all occupations save two, services and farming, the weights are positive. The largest positive effect is in managerial employment. A one per cent increase in male managerial employment increases labour quality by one half of one per cent. Among females, the largest effect is also among managerial workers.

Education and occupation weights are in Table 5.13. Those with no schooling or some grade school all have negative values except for managerial employees, and the numbers in this occupation are negligible. The Census 1/100 sample reveals only one managerial worker with no years of schooling, and 190 with some grade school. The quality weights for the no schooling category tend to be higher, or less negative than those for the some grade school group. This is because members of the former are older, and more experienced. In each case, managerial employees have a positive quality weight.

For those with some high school education, there are three occupational groups with a positive quality weight, namely

Table 5.12 Sex and Occupation Quality Weights, 1971, Canada

Index	Employment (100's)	Compensation ($)	Employment Share (%)	Compensation Share (%)	Quality Weight (%)
Males					
1	2900	37830090	4.1299	9.1459	5.0160
2	3946	35615130	5.6195	8.6104	2.9909
3	1063	9474520	1.5138	2.2906	0.7768
4	3930	24264340	5.5967	5.8662	0.2695
5	4815	35546870	6.8570	8.5939	1.7369
6	4426	25337830	6.3030	6.1257	-0.1773
7	2592	11856300	3.6913	2.8664	-0.8248
8	13392	88287690	19.0715	21.3447	2.2732
9	9709	59250520	13.8265	14.3265	0.4980
Females					
1	535	3474240	0.7619	0.8399	0.0780
2	2427	14181940	3.4563	3.4287	-0.0276
3	2403	10605080	3.4221	2.5639	-0.8582
4	8420	31122930	11.7345	7.5244	-4.2102
5	1901	4916570	2.7072	1.1886	-1.5186
6	3417	7603880	4.8661	1.8383	-3.0278
7	243	472370	0.3461	0.1142	-0.2319
8	1943	6348610	2.7670	1.5349	-1.2322
9	2338	7440090	3.3295	1.7987	-1.5308
Totals	70220	413629000	100.0000	100.0000	0.0000

Note: Occupational codes: 1 Managerial; 2 Science; 3 Recreational, 4 Clerical, 5 Sales, 6 Service, 7 Farming, 8 Processing, 9 Transport

Table 5.13 Education and Occupation Quality Weights, 1971, Canada

Index	Employment (100's)	Compensation ($)	Employment Share (%)	Compensation Share (%)	Quality Weight (%)
No Schooling					
1	1	7000	0.0014	0.0017	0.0003
2	3	14010	0.0043	0.0034	-0.0009
3	3	9540	0.0043	0.0023	-0.0020
4	5	24510	0.0071	0.0059	-0.0012
5	12	65610	0.0171	0.0159	-0.0012
6	76	226600	0.1082	0.0548	-0.0534
7	48	196100	0.0684	0.0474	-0.0209
8	141	634840	0.2008	0.1535	-0.0473
9	163	587440	0.2321	0.1420	-0.0901
Some Grade School					
1	190	2060280	0.2706	0.4981	0.2275
2	147	836420	0.2093	0.2022	-0.0071
3	272	1177400	0.3874	0.2847	-0.1027
4	1026	5112550	1.4611	1.2360	-0.2251
5	1137	6102940	1.6192	1.4755	-0.1437
6	2760	10443590	3.9305	2.5249	-1.4056
7	1275	5667310	1.8157	1.3701	-0.4456
8	6381	36986190	9.0872	8.9419	-0.1453
9	4305	23220430	6.1307	5.6138	-0.5169
Some High School					
1	775	7952620	1.1037	1.9226	0.8190
2	698	4793740	0.9940	1.1589	0.1649
3	957	4390780	1.3629	1.0615	-0.3013
4	4898	22276730	6.9752	5.3857	-1.5895
5	2808	15779210	3.9989	3.8148	-0.1840
6	3191	13534550	4.5443	3.2721	-1.2721
7	932	4204870	1.3273	1.0166	-0.3107
8	5692	36228310	8.1060	8.7586	0.6527
9	4503	25531160	6.4127	6.1725	-0.2402
Completed High School					
1	1045	11494930	1.4882	2.7790	1.2909
2	1526	10160330	2.1732	2.4564	0.2832
3	1252	6031530	1.7815	1.4582	-0.3233
4	4835	21492460	6.8855	5.1961	-1.6894
5	1903	12224500	2.7101	2.9554	0.2454
6	1274	5837110	1.8143	1.4112	-0.4031
7	377	1523830	0.5369	0.3684	-0.1685
8	2401	16350700	3.4193	3.9530	0.5337
9	2281	12819950	3.2484	3.0994	-0.1490

continued...

Table 5.13 (cont'd) Education and Occupation Quality Weights, 1971, Canada

Index	Employment (100's)	Compensation ($)	Employment Share (%)	Compensation Share (%)	Quality Weight (%)
Some Post-Secondary Schooling					
1	476	5465040	0.6779	1.3212	0.6434
2	1330	83093660	1.8940	2.0089	0.1148
3	479	2675890	0.6821	0.6469	-0.0352
4	1015	4485840	1.4455	1.0845	-0.3609
5	607	4106880	0.8644	0.9929	0.1285
6	393	1746070	0.5597	0.4221	-0.1375
7	162	496810	0.2307	0.1204	-0.1104
8	529	2977670	0.7533	0.7199	-0.0335
9	511	2491360	0.7277	0.6023	-0.1254
Undergraduate Degree					
1	457	6822930	0.6508	1.6495	0.9987
2	1201	10393500	1.7103	2.5128	0.8024
3	208	1472850	0.2962	0.3561	0.0599
4	255	1184420	0.3631	0.2863	-0.0768
5	165	1464630	0.2350	0.3541	0.1191
6	91	661140	0.1296	0.1598	0.0302
7	25	163540	0.0356	0.0395	0.0039
8	109	834230	0.1552	0.2017	0.0465
9	156	1105460	0.222	0.2673	0.0451
Postgraduate Degree					
1	491	7501540	0.6992	1.8136	1.1144
2	1468	15289710	2.0906	3.6965	1.6059
3	296	4321610	0.4215	1.0448	0.6233
4	136	810770	0.1937	0.1960	0.0023
5	84	719660	0.1196	0.1740	0.0544
6	58	492660	0.0826	0.1191	0.0365
7	16	75220	0.0228	0.0182	-0.0046
8	82	624390	0.1168	0.1510	0.0342
9	128	934810	0.1823	0.2260	0.0437
Totals	70220	413629000	100.0000	100.0000	0.0000

Note: Occupational codes: 1 Managerial; 2 Science; 3 Recreational, 4 Clerical, 5 Sales, 6 Service, 7 Farming, 8 Processing, 9 Transport

managerial, scientific and processing. The sum of the quality weights is negative, implying that a constant growth rate of employment over occupations reduces labour quality. Similar results are obtained for those who have completed high school. In the some post-secondary schooling group, managerial, scientific and sales employees have positive quality weights.

The large positive contributions arise in the educational groups with post-secondary degrees. In the undergraduate degree sector, only one group, clerical, has a negative weight. A one per cent increase in employment of managerial workers increases labour quality by one tenth of one per cent. The quality weights for managerial and scientific employees are both large, at 0.9987 and 0.8024 respectively. The sum of all other quality effects is much less than 0.5. The conclusion is that skilled and educated workers have a large contribution to quality change.

In the postgraduate degree sector, managerial, science and recreational workers have large quality weights. A one per cent increase in employment in each category raises labour quality respectively by 0.11, 0.16 and 0.06 per cent respectively. At a gross output share for labour of two-fifths, this increases labour productivity alone by 0.04, 0.06 and 0.02 per cent respectively. Annual employment growth of five per cent for managerial postgraduates raises labour productivity growth by 0.2

per cent. Total factor productivity growth, measured as a residual, is accordingly reduced. The education effects point to potential productivity gains for employment increases in skilled jobs.

In Table 5.14 are indicated the age effects. For the age groups 15-19 and 20-29, the quality effects are all negative save for one, managerial workers in the latter group. Skill retraining for younger workers has a negative current effect, although there may be a return as they age. The pattern of large quality weights in managerial and scientific workers remains. For 31-39 year olds, the weights are 1.2062 and 1.2176 respectively, and for 41-49 year olds, the weights are 1.9193 and 1.1192.

For occupational groups, the largest productivity gains arise from employment growth in managerial and scientific workers. These increases are larger the more skilled the workers, notably in post-secondary education. The productivity gains are part of the social return to occupational retraining. Further, these quality weights measure the costs of skill shortages. They measure the gains which could be achieved were these shortages to be alleviated.

Table 5.14 Education and Occupation Quality Weights, 1971, Canada

Index	Employment (100's)	Compensation ($)	Employment Share (%)	Compensation Share (%)	Quality Weight (%)
Age 15 to 19					
1	22	34320	0.0313	0.0083	-0.0230
2	112	142170	0.1595	0.0344	-0.1251
3	160	186300	0.2279	0.0450	-0.1828
4	1067	1916630	1.5195	0.4634	-1.0561
5	640	679070	0.9114	0.1642	-0.7472
6	974	1042300	1.3871	0.2520	-1.1351
7	392	421520	0.5582	0.1019	-0.4563
8	769	1558850	1.0951	0.3769	-0.7183
9	1101	1698360	1.5679	0.4106	-1.1573
Age 20 to 29					
1	646	4528620	0.9200	1.0948	0.1749
2	2618	15259360	3.7283	3.6891	-0.0391
3	1413	6159400	2.0122	1.4891	-0.5231
4	4649	19189660	6.6206	4.6393	-1.9813
5	1552	7864240	2.2102	1.9013	-0.3089
6	1749	7358370	2.4907	1.7790	-0.7118
7	737	2930000	1.0496	0.7084	-0.3412
8	4221	22206320	6.0111	5.3687	-0.6425
9	3468	16762390	4.9388	4.0525	-0.8862
Age 31 to 39					
1	841	9943040	1.1977	2.4039	1.2062
2	1619	14572870	2.3056	3.5232	1.2176
3	743	4982620	1.0581	1.2046	0.1465
4	2090	10660780	2.9764	2.5774	-0.3990
5	1409	10528770	2.0066	2.5455	0.5389
6	1471	8148240	2.0948	1.9699	-0.1249
7	502	2937160	0.7149	0.7101	-0.0048
8	3677	25626320	5.2364	6.1955	0.9591
9	2469	16326520	3.5161	3.9471	0.4310
Age 40 to 49					
1	968	13640570	1.3785	3.2978	1.9193
2	1065	10902530	1.5167	2.6358	1.1192
3	553	4253020	0.7875	1.0282	0.2407
4	2128	11448840	3.0305	2.7679	-0.2626
5	1437	10308250	2.04064	2.4921	0.4457
6	1513	7541070	2.1547	1.8231	-0.3315
7	550	3139200	0.7833	0.7589	-0.0243
8	3448	24453370	4.9103	5.9119	1.0016
9	2343	15730100	3.3367	3.8029	0.4663

Table 5.14 (con't) Education and Occupation Quality Weights, 1971,Canada

Index	Employment (100's)	Compensation ($)	Employment Share (%)	Compensation Share (%)	Quality Weight (%)
Age 50 to 64					
1	893	12572200	1.2717	3.0395	1.7678
2	883	8459000	1.2575	2.0451	0.7876
3	536	4021260	0.7633	0.9722	0.2089
4	2051	11372190	2.9208	2.7494	-0.1715
5	1473	9973410	2.0977	2.4112	0.3135
6	1850	7908210	2.6346	1.9119	-0.7227
7	549	2582770	0.7818	0.6244	-0.1574
8	3014	19803440	4.2922	4.7877	0.4955
9	2290	14471460	3.2612	3.4987	0.2375
Age 65 or Over					
1	65	585590	0.0926	0.1416	0.0490
2	76	461140	0.1082	0.1115	0.0033
3	61	477000	0.0869	0.1153	0.0285
4	185	799170	0.2635	0.1932	-0.0702
5	205	1109710	0.2919	0.2683	-0.0237
6	286	943530	0.4073	0.2281	-0.1792
7	105	319030	0.1495	0.0769	-0.0726
8	206	988030	0.2934	0.2389	-0.0545
9	376	1701790	0.5355	0.4114	0.1240
Totals	70220	413629000	100.0000	100.0000	0.0000

Note: Occupational codes: 1 Managerial; 2 Science; 3 Recreational, 4 Clerical, 5 Sales, 6 Service, 7 Farming, 8 Processing, 9 Transport

Chapter 6. Summary and Conclusions

6.1 Introduction

The results, have been constructed for industry and region shifts from the establishment data and the household data. They apply particularly in the areas of education planning, in indicating the relatively larger contribution of postsecondary education versus elementary education.

Consider the implications for the contribution of Labour quality to productivity growth. Suppose as assumed before that the aggregate labour share of value of gross output is two-fifths.[1] The labour quality growth rate of -0.24 per cent annually translates to a -0.10 per cent change in labour productivity, over the period 1971-1976. Given the magnitude of the labour productivity decline during the period, of several percentage points, shifts in labour quality cannot have contributed substantially to the slowdown. A reduction of 0.1 per cent in labour productivity growth is similar to that estimated in earlier periods for Canada. Hence, the shifts in age-sex composition, educational attainment and region have not been large causal factors of the recent disappearance of productivity change.

The social cost of education includes the opportunity costs of students and the cost of providing educational institutions.

One major component of the social return is the increase in labour quality. It has been demonstrated in the United States that the rate of return to college and university education declined during the early 1970's, as well as the relative earnings of such graduates (Freeman (1976)). Even if a similar occurrence obtains for Canada, a conclusion which cannot be discerned with no education and earnings data in the 1976 Census, it does not necessarily imply a reduced productivity contribution.

The number of graduates has also increased, as has their share of total employment. Even if relative wages of university graduates decline, their absolute earnings remain above average. This implies that the compensation share of graduates is above the employment share. This quality weight, when multiplied by the growth of employment, yields the labour quality effect. Education can continue to contribute to productivity change through the growth of employment.

The results indicate that this process continues in Canada over the 1970's but at a reduced rate. Among the categories, most of the contribution comes from the university sector. If educational planning has proceeded on the basis of the 0.6 per cent annual contribution to labour quality conventionally obtained for the United States, there may be overinvestment. In terms of specific educational levels, the only large contribution

comes from the postsecondary sector. The contribution of primary and secondary education as measured is small.

This study has measured the various components of total labour input in Canada. Establishment data yield inter-industry and inter-regional shifts in employment. From the household data, labour quality measures by sex, age, region, education and occupation are derived. The results indicate substantial shifts in labour quality during 1971-1976.

Some caveats remain. Throughout, wages are equated with marginal products. Should this not be the case, and discrimination arise, the labour quality measures understate the productivity contributions of those discriminated against.

There are no interpolations in the classification. There may be reporting errors in the data from the Census, notably in earnings levels. If the errors are proportionately larger in high wage categories, the contribution of these is understated.

The labour subaggregate is assumed to be linearly homogeneous. The theoretical results on indexing depend on this, and testing is required. If labour inputs are not separable from non-labour inputs, these latter must also be accounted for.

NOTES

Chapter 2

1 Components of labour quality are also discussed as possible factors for the relative decline in productivity performance. The decomposition of the employment-population rate is in Freedman (1977, Table 2).

2 Blain (1977, 7).

3 The connection between labour quality and labour productivity is derived more formally in the technical section of Chapter 3.

4 The required technical conditions are homogeneity of degree one in the production function aggregating capital and labour and efficiency in the markets for capital labour. The wage payable to each is the value of the incremental contribution to output. This sources of growth form is the basic structure of Solow (1957).

5 Walters (1968), Table 30, page 51. Using the earnings relatives of the United States permits her to make comparisons of international productivity. The complete sources of growth form is in Walters (1970).

6 Walters (1968), Table 40, page 65.

7 Cummings, Christensen and Jorgenson (1980), Table II.A 3C, no pagination.

8 The frequent procedure, given the absence of this information, is to interpolate between data points. The problem is discussed in Ostry and Rao (1980, 65).

9 In effect, the aggregation error from using an incorrect functional form is relatively small. Applying various forms to data that exhibited large fluctuations, Allen and Diewert (1982) showed that small differences arose between alternate specifications.

10 This problem is common to both Canada and the United States. In Japan, more extensive payroll survey data permit characteristics such as experience, age and sex to be examined directly as to their effect on labour quality. Given the prevalence of lifetime employment in some sectors of the economy, notably manufacturing, equating annual or weekly wages with annual or weekly marginal products may lead to errors.

11 Ostry and Rao (1980) examine other sectors of the economy with a labour quality index exhibiting no inter-industrial variation.

Chapter 3

1 Since productivity is defined as the ratio of an output index to an index of some or all inputs, the existence of output is required to validate the definition. Output price ratios, for any pair of goods in the output index, must be independent of the level of any input.

2 An alternative starting point is from the dual unit cost function. Given weak separability between labour and non-labour inputs and homotheticity of the production function, there exists a separate wage aggregate in the unit cost function. Hence average wages, total compensation per hour worked, can be compared with the wage index. The wage index is average wages divided by the index of labour quality.

3 The relation between this procedure and translog functions in homogeneous form is derived by Diewert (1976). The Tornqvist terminology is also used here.

4 More detail on the aggregation procedures is contained in Chinloy (1981).

5 Gollop and Jorgenson (1980) apply the procedure in the measurement of labour quality by industry. Each separate industry possesses a classification of employment by sex,

age, education, occupation, and class of worker (employee or self-employed). The aggregate labour quality index, using U.S. data, is then constructed in a form analogous to (24) and (26).

6 There remains the question as to whether gross outputs in y are separable from labour inputs represented by hours worked $h_1,\ldots,h_N$ and non-labour inputs $x_1,\ldots,x_M$ as well as time t. It is assumed that an output subaggregate exists. Also, the existence of value added is not assumed ex ante.

7 This implies Hicks - netural technical change, and the production function is then expressibly $y/m = y(b_1(g(h_1,\ldots, h_N), x_1/m,\ldots,x_M(b_2(t))$.

Chapter 4

1 Ostry and Rao (1980, 59) indicate that in 1972 coverage in the service industry is only 20 per cent, while that for manufacturing is 95 per cent.

2 The description of the average weekly wage and average hourly earnings construction comes from Statistics Canada 72-002 (1980), 126-127.

Notes to Chapter 6

1. This involves the assumption that a value added aggregate of capital and labour can be constructed. If this is not the case, the proportion of labour in gross production can be used.

APPENDIX A. Detail on Industry Classification

This brief document lists the divisions, major groups and Standard Industrial Classification (S.I.C.) codes of the industries used in the Employment study. The source of this information is the Standard Industrial Classification Manual, Catalogue 12-501 (Occassional), Dominion Bureau or Statistics, December 1970, 1200-502.

A division has one or more major groups. A major group has one or more industries. The S.I.C. codes are applicable only to industries. Industry names for the Industries of each group are not shown; only their S.I.C. codes appear. S.I.C. Codes are in sequential order.

List of Divisions

1. Agriculture
2. Forestry
3. Fishing and Trapping
4. Mining (including Milling), Quarries and Oil wells
5. Manufacturing Industries
6. Construction Industry
7. Transport, Communication and Other Utilities
8. Trade
9. Finance, Insurance and Real Estate
10. Community, Business and Personal Services Industries
11. Public Administration and Defense
12. Industry Unspecified or Undefined

This study did not include the following Divisions

1. Agriculture
3. Fishing and Trapping
11. Public Administration and Defense
12. Industry Unspecified or Undefined

hence only 8 out of 12 divisions were used.

Division 2 - Forestry

Major Group 1 - Logging - 031

Major Group 2 - Forestry Services - 039

Division 4 - Mines (including Milling), Quarries and Oil Wells

Major Group 1 - Metal Mines - 051, 052, 057, 058, 059

Major Group 2 - Mineral Fuels - 061, 064

Major Group 3 - Non-Metal Mines (except Coal Mines) - 071, 072, 073, 079

Major Group 4 - Quarries and Sand Pits - 083, 087

Major Group 5 - Services Incidental to Mining - 096, 098, 099

Division 5 - Manufacturing Industries

Major Group 1 - Food and Beverage Industries - 101, 102, 103, 104, 105, 106, 107, 108, 109

Major Group 2 - Tobacco Products Industries - 151, 153

Major Group 3 - Rubber and Plastics Products Industries - 162, 165

Major Group 4 - Leather Industries - 172, 174, 175, 179

Major Group 5 - Textile Industries - 181, 182, 183, 184, 185, 186, 187, 188, 189

Major Group 6 - Knitting Mills - 231, 239

Major Group 7 - Clothing Industries - 243, 244, 245, 246, 248, 249

Major Group 8 - Wood Industries - 251, 252, 254, 256, 258, 259

Major Group 8 - Furniture and Fixtures Industries - 261, 264, 266, 268

Major Group 10 - Paper and Allied Industries - 271, 272, 273, 274

Major Group 11 - Printing, Publishing and Allied Industries - 286, 287, 288, 289

Major Group 12 - Primary Metal Industries - 291, 292, 294, 295, 296, 297, 298

Major Group 13 - Metal Fabricating Industries (except Machinery and Transportation Equipment Industries - 301, 302, 303, 304, 305, 306, 307, 308, 309

Major Group 14 - Machinery Industries (except Electrical Machinery) - 311, 315, 316, 318

Major Group 15 - Transportation Equipment Industries - 321, 323, 324, 325, 326, 327, 328, 329

Major Group 16 - Electrical Products Industries - 331, 332, 333, 334, 335, 336, 338, 339

Major Group 17 - Non-Metalic Mineral Products Industries - 351, 352, 353, 354, 355, 356, 357, 358, 359

Major Group 18 - Petroleum and Coal Products Industries - 365, 369

Major Group 19 - Chemical and Chemical Products Industries - 372, 373, 374, 375, 376, 377, 378, 379

Major Group 20 - Miscellaneous Manufacturing Industries - 391, 392, 393, 397, 399

Division 6 - Construction Industry

Major Group 1 - General Contractors - 404, 406, 409

Major Group 2 - Special-Trade Contractors - 421

Division 7 - Transportation, Communication and Other Utilities

Major Group 1 - Transportation - 501, 502, 503, 504, 505, 506, 507, 508, 509, 512, 515, 517, 519

Major Group 2 - Storage - 524, 527

Major Group 3 - Communication - 543, 544, 545, 548

Major Group 4 - Electric Power, Gas and Water Utilities - 572, 574, 576, 579

Division 8 - Trade

Major Group 1 - Wholesale Trade - 602, 206, 608, 611, 612, 614, 615, 616, 617, 618, 619, 621, 622, 623, 624, 625, 626, 627, 629

Major Group 2 - Retail Trade - 631, 642, 652, 654, 656, 658, 663, 665, 669, 673, 676, 678, 681, 691, 192, 694, 695, 696, 697, 699

Division 9 - Finance, Insurance and Real Estate

Major Group 1 - Finance Industries - 701, 703, 705, 707, 715

Major Group 2 - Insurance Carriers - 721

Major Group 3 - Insurance Agencies and Real Estate Industry- 735, 737

APPENDIX B. Detailed Labour Quality Calculations by Region and Sex

This Appendix reports the calculations of labour quality for each region and sex. There are ten such categories. In the index column, the first entry denotes education and the second age. The categories are:

Education	Age
1. No Schooling	1. 15 - 19
2. Some grade school	2. 20 - 29
3. Some high school	3. 30 - 39
4. Completed high school	4. 40 - 49
5. Some university	5. 50 - 64
6. Some graduate	6. 65 or older
7. Post graduate	

The remaining entries are:

EMP71 employment in the cell, summing of all workers in the 1971 Census having the relevant characteristics

EMP76 total employment in the cell, summing of all workers in the 1976 Census having the relevant characteristics

SHCOMP share of total compensation paid in the 1971 Census

QUAL-SHARE quality share, or difference between the compensation and unemployment shares. This is SHCOMP-(EMP71 + EMP76)/2

EMPGR7176 approximation of growth rate in employment 1971-1976. Taken as natural logarithm of employment

changes, or LN(EMP76)-LN(EMP71)

QUALITY product of quality shares and employment growth. Here QUALITY = QUALSHARE*(LN(EMP76)-LN(LNEMP71)).

A typical entry in the table accompanying is for 2.5 under INDEX. There were 40,300 people employed in this category in 1971 and 40,200 in 1976. The quality term is the sum of all entries.

Because the growth rates are reported as the change in logarithms, large negative values are possible.

TABLE B1. Region, Sex, Education and Age Labour Quality, Canada 1971-1976.

Employment and Labour Quality, 1971 to 1976
(Maritimes:Males)

Index		EMP71 (100s)	EMP76 (100s)	SHCOMP (%)	QUAL SHARE (%)	EMPGR 7176 (%)	QUALITY
1	1	1	0	0.0001	-0.0013		
1	2	2	2	0.0014	-0.0014		
1	3	4	5	0.0031	-0.0026	22.3144	-0.0006
1	4	11	4	0.0102	-0.0055	-101.1601	0.0056
1	5	24	17	0.0228	0.0114	-34.4840	0.0039
1	6	4	1	0.0031	-0.0026	-138.6293	0.0036
2	1	57	63	0.0294	-0.0518	10.0083	-0.0052
2	2	242	189	0.2078	-0.1368	-24.7190	0.0338
2	3	257	188	0.2985	-0.0675	-31.2634	0.0211
2	4	330	285	0.4091	-0.0608	-14.6604	0.0089
2	5	403	402	0.4736	-0.1003	-0.2484	0.0002
2	6	55	49	0.0544	-0.0239	-11.5513	0.0028
3	1	114	173	0.0473	-0.1150	41.7092	-0.0480
3	2	438	314	0.5095	-0.1142	-33.2826	0.0380
3	3	371	269	0.6163	0.0880	-32.1490	-0.0283
3	4	288	246	0.5199	0.1098	-15.7629	-0.0173
3	5	311	257	0.5331	0.0902	-19.0717	-0.0172
3	6	16	35	0.0180	-0.0048	78.2760	-0.0038
4	1	40	55	0.0138	-0.0432	31.8454	-0.0138
4	2	180	181	0.2263	-0.0300	0.5541	-0.0002
4	3	97	74	0.1813	0.0432	-27.0646	-0.0117
4	4	40	31	0.0864	0.0294	-25.4892	-0.0075
4	5	44	27	0.0846	0.0219	-48.8353	-0.0107
4	6	3	2	0.0028	-0.0015	-40.5465	0.0006
5	1	28	77	0.0079	-0.0320	101.1601	-0.0324
5	2	102	479	0.1052	-0.0400	154.6728	-0.0619
5	3	48	303	0.0964	0.0280	184.2532	0.0516
5	4	34	156	0.0824	0.0340	152.3495	0.0518
5	5	26	144	0.0510	0.0140	171.1717	0.0240
5	6	1	16	0.0004	-0.0010	277.2588	-0.0028
6	1	0	0	0.0	0.0		
6	2	38	131	0.0508	-0.0033	123.7611	-0.0041
6	3	18	72	0.0389	0.0133	138.6294	0.0184
6	4	14	35	0.0331	0.0132	91.6290	0.0121
6	5	10	26	0.0273	0.0131	95.5511	0.0125
6	6	1	1	0.0010	-0.0004		
7	1	0	0	0.0	0.0		
7	2	73	21	0.1128	0.0088	-124.5936	-0.0110
7	3	41	46	0.1067	0.0483	11.5069	0.0056
7	4	25	19	0.0901	0.0545	-27.4436	-0.0150
7	5	25	18	0.0851	0.0495	-32.8504	-0.0163
7	6	1	2	0.0020	0.0006	69.3147	0.0004
		3817	4415	5.2439	-0.1915	14.5542	-0.129

Employment and Labour Quality, 1971 to 1976
(Maritimes:Females)

Index	EMP71 (100s)	EMP76 (100s)	SHCOMP (%)	QUAL SHARE (%)	EMPGR 7176 (%)	QUALITY
1 1	1	0	0.0002	-0.0012		
1 2	3	1	0.0021	-0.0022	-109.8612	0.0024
1 3	0	1	0.0	-0.0		
1 4	1	1	0.0002	-0.0012		
1 5	2	2	0.0013	-0.0015		
1 6	1	2	0.0001	-0.0013	69.3147	-0.0009
2 1	25	21	0.0063	-0.0293	-17.4353	0.0051
2 2	34	45	0.0142	-0.0342	28.0301	-0.0096
2 3	44	59	0.0222	-0.0405	29.3347	-0.0119
2 4	73	74	0.0377	-0.0663	1.3606	-0.0009
2 5	75	91	0.0371	-0.0697	19.3372	-0.0135
2 6	9	9	0.0056	-0.0072		
3 1	80	129	0.0194	-0.0945	47.7786	-0.0452
3 2	228	133	0.1494	-0.1753	-53.8997	0.0945
3 3	140	148	0.1030	-0.0964	5.5570	-0.0054
3 4	138	128	0.1044	-0.0921	-7.5223	0.0069
3 5	155	115	0.1102	-0.1105	-29.8493	0.0330
3 6	15	7	0.0101	-0.0113	-76.2140	0.0086
4 1	37	60	0.0111	-0.0416	48.3427	-0.0201
4 2	164	131	0.1375	-0.0960	-22.4669	0.0216
4 3	53	44	0.0472	-0.0283	-18.6102	0.0053
4 4	39	24	0.0354	-0.0201	-48.5508	0.0098
4 5	27	16	0.0257	-0.0127	-52.3249	0.0066
4 6	2	3	0.0012	0.0016	40.5465	-0.0006
5 1	27	81	0.0049	-0.0335	109.8612	-0.0368
5 2	84	355	0.0731	-0.0465	144.1300	-0.0670
5 3	21	152	0.0219	-0.0080	197.9358	-0.0158
5 4	23	98	0.0288	-0.0040	144.9473	-0.0058
5 5	24	94	0.0282	-0.0060	136.5241	-0.0082
5 6	3	8	0.0016	-0.0027	98.0829	-0.0026
6 1	1	2	0.0001	-0.0013	69.3147	-0.0009
6 2	24	94	0.0221	-0.0121	136.5241	-0.0165
6 3	15	31	0.0288	0.0074	72.5937	0.0054
6 4	11	14	0.0194	0.0037	24.1162	0.0009
6 5	7	9	0.0121	0.0021	25.1314	0.0005
6 6	0	2	0.0	0.0		
7 1	0	0	0.0	0.0		
7 2	19	7	0.0237	-0.0034	-99.8529	0.0034
7 3	7	12	0.0147	0.0047	53.8997	0.0025
7 4	10	6	0.0215	0.0073	-51.0826	-0.0037
7 5	5	1	0.0103	0.0032	-160.9437	-0.0052
7 6	1	3	0.0006	-0.0008	109.8612	-0.0009
	1628	2213	1.1934	-1.1249	30.6996	-0.650

Employment and Labour Quality, 1971 to 1976
(Ontario:Males)

Index	EMP71 (100s)	EMP76 (100s)	SHCOMP (%)	QUAL SHARE (%)	EMPGR 7176 (%)	QUALITY
1 1	3	0	0.0009	-0.0034		
1 2	6	4	0.0039	-0.0046	-40.5465	0.0019
1 3	10	3	0.0122	-0.0020	-120.3973	0.0024
1 4	10	17	0.0120	-0.0022	53.0628	-0.0012
1 5	20	27	0.0197	-0.0088	30.0105	-0.0026
1 6	6	7	0.0038	-0.0047	15.4151	-0.0007
2 1	87	80	0.0452	-0.0787	-8.3882	0.0066
2 2	705	443	0.8025	-0.2014	-46.4627	0.0936
2 3	1106	901	1.6012	0.0263	-20.5000	-0.0054
2 4	1198	1205	1.8588	0.1529	0.5826	0.0009
2 5	1210	1535	1.7276	0.0046	23.7910	0.0011
2 6	164	151	0.1643	-0.0692	-8.2586	0.0057
3 1	356	524	0.1528	-0.3541	38.6560	-0.1369
3 2	1551	1332	2.0287	-0.1799	-15.2219	0.0274
3 3	933	921	1.6910	0.3624	-1.2945	-0.0047
3 4	718	667	1.4654	0.4430	-7.3680	-0.0326
3 5	521	513	1.0050	0.2631	-1.5474	-0.0041
3 6	41	45	0.0534	-0.0050	9.3090	-0.0005
4 1	109	212	0.0302	-0.1250	66.5238	-0.0832
4 2	535	620	0.6530	-0.1088	14.7452	-0.0160
4 3	273	245	0.6076	0.2188	-10.8213	-0.0237
4 4	240	208	0.5780	0.2362	-14.3101	-0.0338
4 5	209	163	0.4918	0.1942	-24.8584	-0.0483
4 6	23	21	0.0368	0.0040	-9.0971	-0.0004
5 1	44	358	0.0125	-0.0502	209.6343	-0.1052
5 2	348	1730	0.4430	-0.0525	160.3674	-0.0842
5 3	194	1137	0.4597	0.1834	176.8291	0.3243
5 4	121	616	0.3286	0.1563	162.7457	0.2544
5 5	86	519	0.2117	0.0892	179.7557	0.1603
5 6	16	37	0.0371	0.0143	83.8329	0.0120
6 1	3	2	0.0007	-0.0036	-40.5465	0.0015
6 2	199	361	0.2976	0.0142	59.5573	0.0085
6 3	104	292	0.3191	0.1710	103.2363	0.1765
6 4	86	178	0.2625	0.1400	72.7436	0.1018
6 5	76	129	0.2916	0.1834	52.9078	0.0970
6 6	16	25	0.0368	0.0140	44.6287	0.0062
7 1	0	0	0.0	0.0		
7 2	188	93	0.2994	0.0317	-70.3842	-0.0223
7 3	199	211	0.5832	0.2998	5.8553	0.0176
7 4	127	144	0.4724	0.2916	12.5626	0.0366
7 5	94	72	0.3393	0.2054	-26.6628	-0.0548
7 6	9	16	0.0181	0.0053	57.5364	0.0030
	11944	15764	19.4591	2.4510	27.7499	0.6787

Employment and Labour Quality, 1971 to 1976
(Ontario:Females)

Index	EMP71 (100s)	EMP76 (100s)	SHCOMP (%)	QUAL SHARE (%)	EMPGR 7176 (%)	QUALITY
1 1	3	3	0.0019	-0.0024		
1 2	4	2	0.0023	-0.0034	-69.3146	0.0024
1 3	4	5	0.0017	-0.0040	22.3144	-0.0009
1 4	3	8	0.0015	-0.0028	98.0829	-0.0027
1 5	11	9	0.0071	-0.0086	-20.0671	0.0017
1 6	3	2	0.0019	-0.0024	-40.5465	0.0010
2 1	81	49	0.0386	-0.0767	-50.2628	0.0386
2 2	260	200	0.1773	-0.1929	-26.2364	0.0506
2 3	301	376	0.2158	-0.2128	22.2479	-0.0473
2 4	390	488	0.2950	-0.2604	22.4169	-0.0584
2 5	375	547	0.2890	-0.2450	37.7522	-0.0925
2 6	29	76	0.0189	-0.0224	96.3438	-0.0216
3 1	299	385	0.1374	-0.2884	25.2800	-0.0729
3 2	978	812	0.8782	-0.5145	-18.6009	0.0957
3 3	371	519	0.3798	-0.1485	33.5702	-0.0499
3 4	331	365	0.3425	-0.1288	9.7778	-0.0126
3 5	281	307	0.3057	-0.0944	8.8493	-0.0084
3 6	31	36	0.0316	-0.0125	14.9531	-0.0019
4 1	139	219	0.0565	-0.1414	45.4598	-0.0643
4 2	541	586	0.5312	-0.2392	7.9901	-0.0191
4 3	184	150	0.2343	-0.0277	-20.4301	0.0057
4 4	126	113	0.1563	-0.0231	-10.8894	0.0025
4 5	101	91	0.1339	-0.0099	-10.4260	0.0010
4 6	9	13	0.0118	-0.0010	36.7725	-0.0004
5 1	39	303	0.0099	-0.0456	205.0172	-0.0935
5 2	202	1279	0.2028	-0.0848	184.5566	-0.1565
5 3	81	640	0.1176	0.0023	206.7019	0.0048
5 4	69	341	0.0963	-0.0020	159.7776	-0.0032
5 5	34	252	0.0498	0.0014	200.3068	0.0028
5 6	7	46	0.0103	0.0003	188.2731	0.0006
6 1	0	0	0.0	0.0		
6 2	139	208	0.1636	-0.0343	40.3065	-0.0138
6 3	40	120	0.0686	0.0116	109.8612	0.0127
6 4	20	60	0.0411	0.0126	109.8613	0.0138
6 5	23	47	0.0436	0.0108	71.4654	0.0077
6 6	4	6	0.0032	-0.0025	40.5465	-0.0010
7 1	0	1	0.0	0.0		
7 2	62	30	0.0722	-0.0161	-72.5938	0.0117
7 3	36	38	0.0681	0.0168	5.4068	0.0009
7 4	30	17	0.0650	0.0223	-56.7984	-0.0127
7 5	11	11	0.0212	0.0055		
7 6	3	4	0.0025	-0.0018	28.7682	-0.0005
	5655	8764	5.2860	-2.7667	43.8112	-0.4799

Employment and Labour Quality, 1971 to 1976
(Quebec:Males)

Index	EMP71 (100s)	EMP76 (100s)	SHCOMP (%)	QUAL SHARE (%)	EMPGR 7176 (%)	QUALITY
1 1	2	1	0.0004	-0.0024	-69.3147	0.0017
1 2	15	11	0.0180	-0.0034	-31.0155	0.0011
1 3	25	19	0.0371	0.0015	-27.4436	-0.0004
1 4	25	25	0.0353	-0.0003		
1 5	43	46	0.0528	-0.0084	6.7441	-0.0006
1 6	8	11	0.0087	-0.0027	31.8454	-0.0009
2 1	99	73	0.0506	-0.0904	-30.4661	0.0275
2 2	582	366	0.7858	-0.0430	-46.3838	0.0199
2 3	1072	787	1.8145	0.2880	-30.9052	-0.0890
2 4	1279	1189	2.2489	0.4276	-7.2966	-0.0312
2 5	1464	1501	2.3329	0.2482	2.4960	0.0062
2 6	269	233	0.2798	-0.1033	-14.3673	0.0148
3 1	593	891	0.2118	-0.6326	40.7150	-0.2576
3 2	1563	1326	2.2917	0.0660	-16.4440	-0.0109
3 3	1417	1069	2.7450	0.7272	-28.1818	-0.2049
3 4	1271	1029	2.6779	0.8680	-21.1217	-0.1833
3 5	1100	1048	2.1586	0.5922	-4.8427	-0.0287
3 6	86	106	0.1173	-0.0052	20.9092	-0.0011
4 1	385	580	0.1336	-0.4146	40.9784	-0.1699
4 2	1742	1392	2.5387	0.0581	-22.4292	-0.0130
4 3	892	721	2.0001	0.7299	-21.2827	-0.1553
4 4	787	614	1.9652	0.8445	-24.8234	-0.2096
4 5	759	626	1.7916	0.7108	-19.2651	-0.1369
4 6	85	76	0.1265	0.0055	-11.1917	-0.0006
5 1	92	227	0.0332	-0.0978	90.3162	-0.0883
5 2	635	2225	0.6845	-0.2197	125.3887	-0.2755
5 3	267	1380	0.6429	0.2627	164.2591	0.4315
5 4	204	1051	0.6044	0.3139	163.9378	0.5146
5 5	169	874	0.4279	0.1872	164.3182	0.3076
5 6	14	114	0.0189	-0.0010	209.7141	-0.0021
6 1	2	0	0.0015	-0.0013		
6 2	290	643	0.4326	0.0196	79.6264	0.0156
6 3	208	559	0.6309	0.3347	98.8611	0.3309
6 4	179	266	0.6968	0.4419	39.6111	0.1750
6 5	108	225	0.4342	0.2804	73.3969	0.2058
6 6	12	32	0.0192	0.0021	98.0829	0.0021
7 1	0	0	0.0	0.0		
7 2	233	158	0.4049	0.0731	-38.8444	-0.0284
7 3	271	293	0.8514	0.4655	7.8053	0.0363
7 4	188	174	0.8254	0.5577	-7.7387	-0.0432
7 5	141	128	0.6241	0.4233	-9.6729	-0.0409
7 6	9	22	0.0214	0.0086	89.3818	0.0077
	18585	22111	33.7770	7.3121	17.3720	0.1260

Employment and Labour Quality, 1971 to 1976
(Quebec:Females)

Index	EMP71 (100s)	EMP76 (100s)	SHCOMP (%)	QUAL SHARE (%)	EMPGR 7176 (%)	QUALITY
1 1	2	1	0.0002	-0.0026	-69.3147	0.0018
1 2	9	5	0.0061	-0.0067	-58.7787	0.0039
1 3	14	14	0.0111	-0.0088		
1 4	13	24	0.0109	-0.0076	61.3104	-0.0047
1 5	14	18	0.0132	-0.0067	25.1314	-0.0017
1 6	8	9	0.0054	-0.0060	11.7783	-0.0007
2 1	39	44	0.0206	-0.0349	12.0628	-0.0042
2 2	206	180	0.1436	-0.1497	-13.4920	0.0202
2 3	338	329	0.2511	-0.2302	-2.6988	0.0062
2 4	497	521	0.3816	-0.3261	4.7160	-0.0154
2 5	523	629	0.4221	-0.3226	18.4550	-0.0595
2 6	100	89	0.1162	-0.0262	-11.6533	0.0031
3 1	375	626	0.1069	-0.4271	51.2424	-0.2189
3 2	816	675	0.6674	-0.4946	-18.9701	0.0938
3 3	731	695	0.6095	-0.4314	-5.0502	0.0218
3 4	712	669	0.6513	-0.3626	-6.2293	0.0226
3 5	640	595	0.6018	-0.3096	-7.2906	0.0226
3 6	46	52	0.0401	-0.0254	12.2602	-0.0031
4 1	428	609	0.1359	-0.4736	35.2695	-0.1670
4 2	1490	1166	1.4684	-0.6534	-24.5197	0.1602
4 3	590	549	0.6250	-0.2152	-7.2024	0.0155
4 4	551	477	0.5973	-0.1873	-14.4218	0.0270
4 5	508	442	0.6141	-0.1093	-13.9172	0.0152
4 6	56	35	0.0600	-0.0197	-47.0004	0.0093
5 1	63	238	0.0146	-0.0751	132.9136	-0.0998
5 2	310	1673	0.2915	-0.1499	168.5801	-0.2527
5 3	117	898	0.1623	-0.0043	203.7996	-0.0088
5 4	102	640	0.1380	-0.0072	183.6495	-0.0132
5 5	98	589	0.1506	0.0110	179.3459	0.0197
5 6	8	67	0.0106	-0.0008	212.5251	-0.0017
6 1	0	0	0.0	0.0		
6 2	193	488	0.2170	-0.0578	92.7626	-0.0536
6 3	55	175	0.1007	0.0224	115.7453	0.0259
6 4	40	93	0.0717	0.0147	84.3720	0.0124
6 5	43	63	0.0872	0.0260	38.1934	0.0099
6 6	2	8	0.0032	0.0004	138.6293	0.0006
7 1	0	1	0.0	0.0		
7 2	81	61	0.1189	0.0036	-28.3575	-0.0010
7 3	43	62	0.0829	0.0217	36.5934	0.0079
7 4	42	27	0.0968	0.0370	-44.1833	-0.0163
7 5	30	27	0.0715	0.0288	-10.5360	-0.0030
7 6	1	1	0.0005	-0.0009		
	9934	13564	9.1778	-4.9677	31.1456	-0.4257

Employment and Labour Quality, 1971 to 1976
(Prairies:Males)

Index		EMP71 (100s)	EMP76 (100s)	SHCOMP (%)	QUAL SHARE (%)	EMPGR 7176 (%)	QUALITY
1	1	1	0	0.0001	-0.0013		
1	2	6	2	0.0050	-0.0035	-109.8611	0.0038
1	3	6	6	0.0048	-0.0037		
1	4	19	7	0.0141	-0.0130	-99.8529	0.0130
1	5	20	9	0.0195	-0.0090	-79.8508	0.0072
1	6	6	11	0.0036	-0.0049	60.6136	-0.0030
2	1	39	56	0.0168	-0.0387	36.1791	-0.0140
2	2	219	142	0.2436	-0.0683	-43.3245	0.0296
2	3	363	299	0.5332	0.0163	-19.3959	-0.0032
2	4	461	496	0.7049	0.0484	7.3178	0.0035
2	5	552	780	0.7074	-0.0786	34.5746	-0.0272
2	6	84	176	0.0856	-0.0340	73.9667	-0.0251
3	1	285	519	0.0897	-0.3161	59.9415	-0.1895
3	2	682	578	0.9022	-0.0690	-16.5456	0.0114
3	3	621	497	1.1459	0.2616	-22.2741	-0.0583
3	4	510	548	0.9668	0.2406	7.1864	0.0173
3	5	492	570	0.8650	0.1644	14.7157	0.0242
3	6	41	82	0.0452	-0.0132	69.3148	-0.0091
4	1	193	250	0.0758	-0.1990	25.8771	-0.0515
4	2	738	709	0.9560	-0.0949	-4.0088	0.0038
4	3	338	333	0.7151	0.2338	-1.4904	-0.0035
4	4	210	208	0.4513	0.1523	-0.9569	-0.0015
4	5	166	168	0.3459	0.1095	1.1976	0.0013
4	6	21	21	0.0269	-0.0030		
5	1	77	140	0.0250	-0.0846	59.7836	-0.0506
5	2	285	1121	0.2867	-0.1191	136.9487	-0.1631
5	3	109	617	0.2364	0.0812	173.3521	0.1408
5	4	69	460	0.1710	0.0727	189.7120	0.1379
5	5	69	331	0.1622	0.0639	156.8012	0.1002
5	6	10	50	0.0162	0.0020	160.9438	0.0032
6	1	2	3	0.0021	-0.0007	40.5465	-0.0003
6	2	130	285	0.1673	-0.0178	78.4955	-0.0140
6	3	82	217	0.2398	0.1230	97.3178	0.1197
6	4	41	97	0.1553	0.0969	86.1139	0.0834
6	5	36	55	0.1135	0.0622	42.3815	0.0264
6	6	2	8	0.0018	-0.0010	138.6293	-0.0014
7	1	0	0	0.0	0.0		
7	2	115	42	0.1717	0.0079	-100.7262	-0.0080
7	3	127	106	0.3449	0.1641	-18.0748	-0.0297
7	4	66	56	0.2137	0.1197	-16.4303	-0.0197
7	5	46	42	0.1720	0.1065	-9.0972	-0.0097
7	6	3	4	0.0158	0.0115	28.7682	0.0033
		7342	10101	11.4198	0.9651	31.9023	0.0476

Employment and Labour Quality, 1971 to 1976
(Prairies:Females)

Index	EMP71 (100s)	EMP76 (100s)	SHCOMP (%)	QUAL SHARE (%)	EMPGR 7176 (%)	QUALITY
1 1	3	0	0.0008	-0.0035		
1 2	8	1	0.0038	-0.0076	-207.9441	0.0158
1 3	5	1	0.0028	-0.0043	-160.9437	0.0069
1 4	2	6	0.0010	-0.0018	109.8611	-0.0020
1 5	9	4	0.0044	-0.0084	-81.0930	0.0068
1 6	5	7	0.0017	-0.0054	33.6473	-0.0018
2 1	11	17	0.0029	-0.0128	43.5318	-0.0056
2 2	59	51	0.0384	-0.0456	-14.5712	0.0066
2 3	90	86	0.0531	-0.0751	-4.5463	0.0034
2 4	147	178	0.0889	-0.1204	19.1351	-0.0230
2 5	224	287	0.1471	-0.1719	24.7836	-0.0426
2 6	35	53	0.0239	-0.0259	41.4944	-0.0107
3 1	131	344	0.0308	-0.1557	96.5445	-0.1503
3 2	304	226	0.2190	-0.2139	-29.6494	0.0634
3 3	267	312	0.1902	-0.1900	15.5755	-0.0296
3 4	317	354	0.2404	-0.2110	11.0394	-0.0233
3 5	291	348	0.2507	-0.1637	17.8880	-0.0293
3 6	16	29	0.0098	-0.0130	59.4707	-0.0077
4 1	201	268	0.0573	-0.2289	28.7682	-0.0659
4 2	530	472	0.4709	-0.2838	-11.5898	0.0329
4 3	176	168	0.1641	-0.0865	-4.6520	0.0040
4 4	169	143	0.1697	-0.0710	-16.7054	0.0119
4 5	130	111	0.1321	-0.0530	-15.8004	0.0084
4 6	11	9	0.0084	-0.0073	-20.0671	0.0015
5 1	50	140	0.0092	-0.0620	102.9619	-0.0638
5 2	201	796	0.1673	-0.1189	137.6294	-0.1636
5 3	70	390	0.0857	-0.0140	171.7651	-0.0240
5 4	50	288	0.0710	-0.0002	175.0937	-0.0004
5 5	63	320	0.0869	-0.0028	162.5186	-0.0046
5 6	3	31	0.0023	-0.0020	233.5375	-0.0047
6 1	0	0	0.0	0.0		
6 2	100	220	0.1069	-0.0355	78.8458	-0.0280
6 3	23	72	0.0401	0.0073	114.1172	0.0083
6 4	21	43	0.0477	0.0178	71.6678	0.0128
6 5	22	39	0.0518	0.0205	57.2519	0.0117
6 6	0	3	0.0	0.0		
7 1	0	0	0.0	0.0		
7 2	27	17	0.0381	-0.0003	-46.2624	0.0001
7 3	11	22	0.0158	0.0001	69.3147	0.0001
7 4	10	14	0.0154	0.0012	33.6473	0.0004
7 5	17	10	0.0443	0.0201	-53.0628	-0.0107
7 6	0	0	0.0	0.0		
	3809	5880	3.0947	-2.3292	43.4190	-0.4966

Employment and Labour Quality, 1971 to 1976
(B.C.:Males)

Index	EMP71 (100s)	EMP76 (100s)	SHCOMP (%)	QUAL SHARE (%)	EMPGR 7176 (%)	QUALITY
1 1	2	0	0.0011	-0.0017		
1 2	1	4	0.0022	0.0008	138.6293	-0.0011
1 3	7	3	0.0148	0.0048	-84.7298	-0.0041
1 4	6	5	0.0081	-0.0004	-18.2322	0.0001
1 5	13	5	0.0154	-0.0031	-95.5512	0.0030
1 6	0	1	0.0	0.0		
2 1	10	14	0.0037	-0.0105	33.6473	-0.0035
2 2	106	80	0.1536	0.0027	-28.1413	-0.0008
2 3	198	115	0.3577	0.0757	-54.3335	-0.0411
2 4	270	255	0.4977	0.1132	-5.7158	-0.0065
2 5	348	288	0.5651	0.0696	-18.9242	-0.0132
2 6	49	39	0.0562	-0.0136	-22.8259	0.0031
3 1	159	249	0.0546	-0.1718	44.8548	-0.0771
3 2	376	365	0.5688	0.0334	-2.9692	-0.0010
3 3	411	321	0.8449	0.2596	-24.7152	-0.0642
3 4	392	327	0.7924	0.2342	-18.1301	-0.0425
3 5	357	344	0.6967	0.1883	-3.7094	-0.0070
3 6	20	28	0.0293	0.0008	33.6473	0.0003
4 1	124	161	0.0620	-0.1146	26.1123	-0.0299
4 2	551	451	0.8437	0.0591	-20.0268	-0.0118
4 3	336	245	0.7410	0.2625	-31.5853	-0.0829
4 4	247	164	0.5771	0.2254	-40.9522	-0.0923
4 5	241	190	0.5340	0.1908	-23.7773	-0.0454
4 6	32	24	0.0398	-0.0058	-28.7683	0.0017
5 1	29	77	0.0097	-0.0316	97.6510	-0.0309
5 2	193	724	0.2153	-0.0595	132.2102	-0.0787
5 3	80	514	0.1713	0.0574	186.0197	0.1068
5 4	74	368	0.1650	0.0596	160.4017	0.0956
5 5	50	327	0.1229	0.0517	187.7937	0.0971
5 6	4	31	0.0125	0.0068	204.7693	0.0139
6 1	0	0	0.0	0.0		
6 2	56	160	0.0757	-0.0040	104.9822	-0.0042
6 3	32	151	0.0896	0.0440	155.1544	0.0683
6 4	27	65	0.0732	0.0348	87.8551	0.0306
6 5	23	86	0.0828	0.0500	131.8853	0.0659
6 6	3	3	0.0093	0.0050		
7 1	0	0	0.0	0.0		
7 2	73	28	0.1377	0.0337	-95.8255	-0.0323
7 3	74	73	0.2072	0.1018	-1.3606	-0.0014
7 4	58	49	0.2402	0.1576	-16.8623	-0.0266
7 5	47	32	0.1871	0.1202	-38.4412	-0.0462
7 6	8	6	0.0075	-0.0039	-28.7683	0.0011
	5087	6372	9.2669	2.0230	22.5225	-0.2550

Employment and Labour Quality, 1971 to 1976
(B.C.:Females)

Index	EMP71 (100s)	EMP76 (100s)	SHCOMP (%)	QUAL SHARE (%)	EMPGR 7176 (%)	QUALITY
1 1	0	0	0.0	0.0		
1 2	1	0	0.0005	-0.0009		
1 3	4	5	0.0030	-0.0027	22.3144	-0.0006
1 4	4	4	0.0027	-0.0030		
1 5	6	6	0.0035	-0.0050		
1 6	3	2	0.0018	-0.0025	-40.5465	0.0010
2 1	4	9	0.0014	-0.0043	81.0930	-0.0035
2 2	35	25	0.0242	-0.0256	-33.6473	0.0086
2 3	36	57	0.0249	-0.0264	45.9533	-0.0121
2 4	70	80	0.0528	-0.0469	13.3531	-0.0063
2 5	102	107	0.0824	-0.0628	4.7856	-0.0030
2 6	7	10	0.0051	-0.0049	35.6675	-0.0017
3 1	89	155	0.0212	-0.1055	55.4789	-0.0585
3 2	142	135	0.1072	-0.0950	-5.0552	0.0048
3 3	141	191	0.1067	-0.0941	30.3514	-0.0286
3 4	169	170	0.1337	-0.1070	0.5899	-0.0006
3 5	172	139	0.1463	-0.0986	-21.3021	0.0210
3 6	14	11	0.0132	-0.0067	-24.1162	0.0016
4 1	137	186	0.0457	-0.1494	30.5766	-0.0457
4 2	381	404	0.3522	-0.1903	5.8616	-0.0112
4 3	154	167	0.1543	-0.0650	8.1041	-0.0053
4 4	155	151	0.1471	-0.0736	-2.6145	0.0019
4 5	154	98	0.1647	-0.0546	-45.1985	0.0247
4 6	10	13	0.0098	-0.0044	26.2364	-0.0012
5 1	37	86	0.0103	-0.0424	84.3430	-0.0358
5 2	142	510	0.1247	-0.0775	127.8584	-0.0991
5 3	36	302	0.0384	-0.0129	212.6908	-0.0274
5 4	27	204	0.0284	-0.0100	202.2283	-0.0202
5 5	29	186	0.0370	-0.0043	185.8451	-0.0080
5 6	4	12	0.0029	-0.0028	109.8613	-0.0031
6 1	0	0	0.0	0.0		
6 2	49	135	0.0458	-0.0240	101.3454	-0.0243
6 3	20	49	0.0336	0.0051	89.6089	0.0046
6 4	6	27	0.0097	0.0012	150.4078	0.0018
6 5	12	31	0.0249	0.0078	94.9080	0.0074
6 6	0	0	0.0	0.0		
7 1	0	0	0.0	0.0		
7 2	29	7	0.0322	-0.0091	-142.1386	0.0129
7 3	12	15	0.0136	-0.0035	22.3144	-0.0008
7 4	12	11	0.0232	0.0061	-8.7011	-0.0005
7 5	18	8	0.0516	0.0260	-81.0930	-0.0211
7 6	1	0	0.0005	-0.0009		
	2424	3708	2.0812	-1.3704	42.5074	-0.3283

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